THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

[FOUNDED IN 1906 AS THE AMERICAN QUARTERLY OF ROENTGENOLOGY]
OFFICIAL ORGAN OF
THE AMERICAN ROENTGEN RAY SOCIETY
AND THE AMERICAN RADIUM SOCIETY

VOL. XIX JUNE, 1928 No. 6

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The subscription price of The American Journal of Roentgenology and Radium Therapy is $10.00 per year, in advance, in the United States, $11.00 in Canada and $12.00 in foreign countries. Current single numbers $1.50. Prices for back numbers will be quoted on request.

Entered as second-class matter, March 3, 1916, at the Post Office, New York, N. Y., under the act of March 3, 1879.
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Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 5, 1919.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XIX JUNE, 1928 No. 6

THE ROENTGEN-RAY DIAGNOSIS OF PULMONARY INFECTIONS WITH THE FRIEDLÄNDER BACILLUS*

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INTRODUCTION

THE Friedländer bacillus, or *Bacillus mucosus capsulatus*, as a cause of pneumonia has received but sporadic attention since Fränkel[1b] and Weichselbaum[1c] recognized that it was not the organism responsible for true lobar or croupous pneumonia as announced by Friedländer[1a] in 1882. That this bacillus does cause a form of pneumonia that is a pathological entity is generally accepted, and various writers have dealt with the subject both clinically and pathologically. There has, however, been very little written regarding its roentgen-ray appearances. A number of references have been made in the literature to roentgen-ray examinations, and Westermark[2] has reported a case dealing principally with the close roentgenological resemblance between Friedländer's pneumonia and pulmonary tuberculosis. There are several reasons for this apparent neglect in the recognition of this disease roentgenologically. In the first place, the condition is not a common one, the incidence being placed variously at from 5 to 10 per cent of all cases of pneumonia. By some writers, even this percentage is thought to be too high, especially in this country. Secondly, the disease is frequently of such short duration and may simulate lobar pneumonia so closely that the true nature of the condition is not recognized.

From the cases reported in the literature the impression is obtained that the disease is almost invariably fatal. Along with Belk,[3] however, we believe that there is a chronic form of pulmonary infection due to *Bacillus mucosus capsulatus*, and that while the condition may be chronic from the beginning, it is entirely possible that many of these chronic forms start as typical cases of acute Friedländer's pneumonia and subsequently recover. We have come to regard this recovery as much the same as that occurring in acute pulmonary tuberculosis, the disease merely becomes latent or quiescent and at any time may become active again. So close is the resemblance between this chronic form of the disease and tuberculosis that Belk has made the suggestion that it would seem worth while to examine certain so-called tuberculous patients, in whom the tubercle bacillus cannot be found, for the Friedländer bacillus.

CLINICAL ASPECTS

Clinically, Friedländer's pneumonia is quite variable. The onset may be insidious, several days elapsing before the symptoms

* Read by invitation before the PHILADELPHIA ROENTGEN RAY SOCIETY, Nov. 3, 1927.

have fully developed. On the other hand, the disease may be as acute in its onset as true croupous pneumonia, and there is often the history of exposure to cold followed in a few hours by a chill with a sudden rise in temperature, pain in the chest and the development of a cough with blood-tinged expectoration. The temperature and leucocyte count are rarely as high as in croupous pneumonia, the former averaging about 102°F., and the latter from 12,000 to 15,000. The physical signs are those of a lobar pneumonia and this is the usual tentative diagnosis, although certain features of the case may be such as to make it appear as an atypical form of croupous pneumonia. A fatal termination may occur with remarkable rapidity, Sisson and Thompson[4] reporting a case in a patient who died thirty-six hours after the onset of the disease. The patient, on the other hand, may continue critically ill for several weeks before death occurs. Exceptionally, however, after a few days of acute illness the temperature becomes normal and there is considerable clinical improvement although the physical signs persist. Within a short time the temperature again becomes elevated and now assumes a septic form. This trend of events leads to the clinical consideration of various complications. The physical signs are often those of an unresolved pneumonia, pleural effusion or encapsulated empyema. In this stage the condition is very likely to be confused with tuberculosis and, reasoning in retrospect, the initial acute manifestations come to be regarded as a tuberculous pneumonia. This septic type of temperature may continue for an indefinite period. It gradually subsides, however, the patient slowly regains his strength and the physical signs clear up although they may never entirely disappear.

The clinical diagnosis is based upon bacteriological studies of the blood and sputum. A positive blood culture for *Bacillus mucosus capsulatus*, while highly desirable from the standpoint of diagnosis, is, as in many other diseases, not always obtainable. Chief reliance must therefore be placed upon studies of the sputum, although certain writers deem this insufficient evidence upon which to base a diagnosis. The sputum in this disease has often been described as being copious, slimy, tenacious and mucoid, and while this is not pathognomonic of a Friedländer infection it is nevertheless quite suggestive. The Friedländer bacillus will usually be found in large numbers in such sputum and while other organisms may be present, the encapsulated bacillus soon comes to be the predominant one, and cultures of the sputum frequently yield the organism in pure culture. Positive sputum cultures, along with the suggestive clinical course of the disease and the characteristic roentgen-ray appearance are sufficient evidence, we believe, upon which to base a diagnosis of Friedländer's pneumonia.

During the past year we have had the opportunity to study roentgenologically 3 cases of Friedländer's pneumonia from the service of Dr. Alfred Stengel, University Hospital. It was the good fortune of these patients to recover. We have made, in addition, a single roentgenogram from a fatal case of the disease, a patient of Dr. Robert Torrey. The clinical course and the basis for diagnosis in these cases were essentially as outlined above.

PATHOLOGY

Our knowledge of the roentgen-ray appearance in Friedländer's pneumonia is based upon a study of the underlying pathology. Briefly, the pathology in the initial stage is that of a bronchopneumonia. The patchy pneumonic consolidations soon coalesce to form larger areas, giving rise to an appearance that has been described as a pseudo-lobar pneumonia. After a variable time a process occurs which appears to be quite characteristic of the disease, namely, a rapid and extensive destruction of the lung tissue leading to abscess and cavity formation. These abscesses may occur early in the disease, Belk reporting abscess formation as early as the fourth day. The same writer calls attention to a feature of these abscesses which is quite important from a roentgenological consideration, and that is the apparent absence of any definite abscess wall. Such abscesses and the cavities resulting therefrom possess extremely thin and

delicate walls. It is during this stage of extensive lung destruction that death usually occurs and with this our pathological knowledge of the disease terminates. Little reference is made to what occurs in the cases that recover.

FIG. 1. Case 1. Friedländer's pneumonia. A bedside examination, showing the transition from a bronchopneumonia to a pseudo-lobar pneumonia.

FIG. 2. Case 1. Friedländer's pneumonia. The second or pseudo-lobar stage. Note the density and peripheral distribution of the consolidations. Bedside examination.

From our roentgenological studies we believe that the residual pathology resulting from an acute Friedländer infection is a more or less marked fibrosis in the involved areas with or without cavities. This fibrosis is probably, to a certain extent, permanent, although a lesion may clear up entirely.

From this pathological consideration of Friedländer's pneumonia we have come to recognize roentgenologically four distinct stages of the disease, the initial stage of bronchopneumonia, the second stage of pseudo-lobar pneumonia, the third stage of multiple abscess and cavity formation, and the final healing stage or stage of fibrosis.

CASE REPORTS*

CASE 1. The first of the cases studied by us was an Italian, a diabetic, aged fifty, who was admitted to the University Hospital on Jan. 8, 1927, in diabetic coma. Four days after admission he developed an irregular fever for which no adequate cause could be found. During the next four days physical signs developed in the right chest indicative of a bronchopneumonia. The following day, a bedside roentgen-ray examination was made (Fig. 1). This shows a pneumonic process involving the entire right lung and represents the transition from the first to the second stage of a Friedländer's pneumonia. The process is losing its bronchopneumonic appearance, the lobular consolidations coalescing to form larger areas shown in Figure 2, an examination made twelve days after the first. This has the typical pseudo-lobar appearance and is illustrative of the second stage of the disease. The lesions are quite dense and have a peripheral distribution. Figure 3, taken twelve days later, shows an extensive destruction of the lung tissue in the involved areas resulting in the formation of numerous abscesses and cavities. This is typical of the third stage. From this point gradual resolution occurred, as revealed by roentgen-ray examinations at weekly intervals. Clinically, the patient gradually improved and was discharged from the hospital, April 20, three and one-half months after the onset of the disease. The diabetic process was under control a short time after his admission and was not responsible for his long stay in the hospital. Figure 4 shows the pulmonary condition a week prior to his discharge. There is now a marked fibrosis of the entire right lung with numerous cavities remaining. This is the fourth and final stage of the disease. In Figure 5 we have the condition five and one-half

* These cases are reported through the courtesy of Dr. Alfred Stengel. The clinical aspects are being published in greater detail elsewhere by Dr. Leon Collins.

months later, and nine months after the initial onset. There remains a general fibrosis of the right lung with several cavities still discernible.

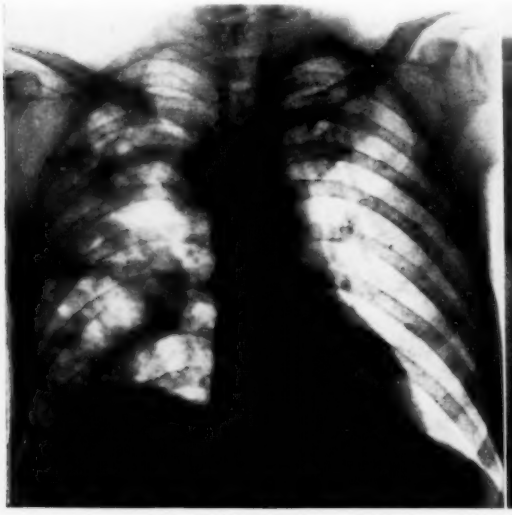

FIG. 3. Case 1. Friedländer's pneumonia. A typical third stage appearance showing the development of numerous abscesses and cavities. Bedside examination.

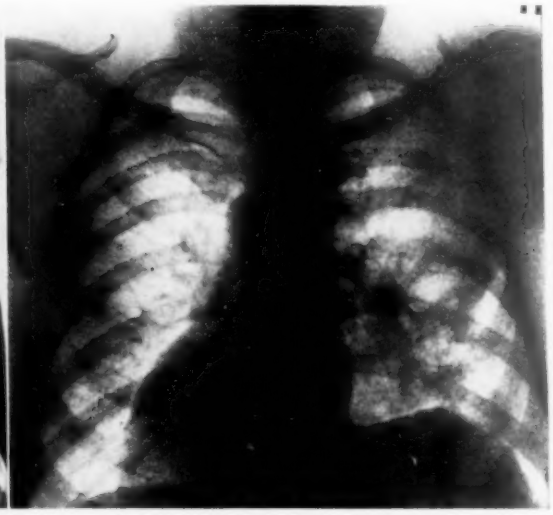

FIG. 4. Case 1. Friedländer's pneumonia. The fourth stage of the disease showing the marked fibrosis of the involved areas in the right lung with numerous cavities. Erect posture.

The extreme thinness of the walls of these cavities and the absence of any lung reaction around them are well shown. At the time of this examination the patient was well and without physical signs.

CASE II. A woman aged fifty, was admitted to the Hospital on Feb. 9, 1927, with a chief complaint of cough and extreme weakness. For the past year there had been ready fatigue, general weakness, a slight cough with some yellowish expectoration. These were residual symptoms from two attacks of grippe from which she did not seem to entirely recover. On Jan. 30, 1927, she started another attack of grippe with cough and blood-tinged expectoration. Five days later she had a chill, her temperature became elevated to 102°F., she developed pain in the chest and her cough became aggravated. During the next five days the acute symptoms subsided but the cough and extreme weakness persisted and it was for these symptoms that she came to the hospital.

The history in this case and the physical signs on admission suggested the diagnosis of chronic pulmonary tuberculosis with an acute tuberculous pneumonia superimposed. A bedside roentgen-ray examination made the day following, revealed partial consolidation of the left upper and lower lobes, with the heart and mediastinal structures drawn toward the affected side. The condition represented the second stage of Friedländer's pneumonia. Resolution gradually occurred with clinical improvement especially in the left upper lobe, where a large abscess developed, as shown in Figures 6 and 7. This examination was made a

FIG. 5. Case 1. Friedländer's pneumonia. This shows the pulmonary condition five and one-half months later. Note the persistence of its fibrosis and the extremely thin-walled cavities in the right lung. Erect posture.

month after admission. Subsequently the lesion in the left upper lobe cleared, the fluid level disappeared from the abscess and left a large

cavity. The patient was discharged April 6, two months after admission.

Roentgen-ray examination at that time revealed a large cavity still present in the left upper lobe with the lesion in the left lower lobe remaining much the same as on admission. The patient returned for a follow-up examination on Oct. 26. In the interim there had been considerable improvement in her general health with some gain in weight. She had had, however, several attacks of so-called grippe with hemoptysis. Figure 8 shows the roentgen-ray examination in October. The large cavity in the left upper lobe can still be very faintly made out. The lesion in the lower lobe remains unchanged. In the light of frequent roentgenologic examinations this case came to be regarded as an example of a chronic Friedländer infection with an acute exacerbation in February. The attacks of grippe during the preceding year had evidently been due to the *Bacillus mucosus capsulatus* involving the left lower lobe. The marked fibrosis in this region with the displacement of the heart and mediastinal structures toward the affected side which were present on admission and which did not change the entire time the patient was under observation, along with a continuation after discharge from the hospital of the same sort of history as before admission, would tend to give weight to this conclusion.

FIG. 6. Case II. Friedländer's pneumonia, third stage. There is a large abscess in the left upper lobe with marked fibrosis in the left lower lobe. Note the displacement of the heart and mediastinal structures toward the affected side. Erect posture.

This case well illustrates the importance of differential diagnosis, for the history would surely suggest tuberculosis and the roentgen-ray appearance is not incompatible with such a diagnosis.

FIG. 7. Case II. Friedländer's pneumonia, third stage. A lateral view showing the abscess with its fluid level in the left upper lobe and thickening of the interlobar pleura. Erect posture.

CASE III. A colored male, aged forty-three, was admitted to the hospital on March 5, 1927. In the middle of February he had had an ordinary head cold. Two weeks later, March 1, he was taken with a severe chill while at work. He went home and to bed. Several hours later he developed a severe pain in the right chest. With this there came a cough accompanied by yellowish sputum streaked with blood. That night he had a second chill. He remained in bed the next day. On the third day he felt somewhat better and was able to be up. He continued to feel badly, however, was very weak and mentally confused. He was admitted to the hospital on the fifth day of his illness. His past medical history revealed the fact that he had had five attacks of lung trouble which apparently were pneumonias.

A roentgenogram made the third day after admission showed consolidation of the right upper and left lower lobes. During the next few weeks the condition in the right upper lobe improved but the lesion persisted in the left

lower lobe. A month after the onset a reinfection occurred in the right upper lobe while the left lower consolidation remained unchanged, next two weeks resolution occurred in both lesions, but in the meantime the left upper lobe became consolidated. This lesion developed the

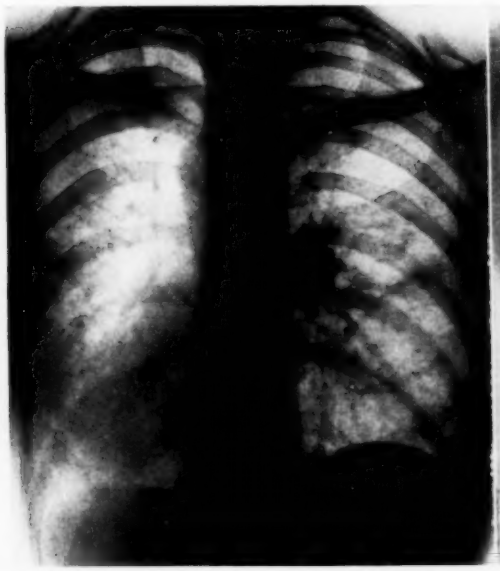

FIG. 8. Case II. Friedländer's pneumonia, fourth stage. An examination eight months after onset of the disease. Note the large, thin-walled cavity remaining in the left upper lobe. The lesion in the left lower lobe has not changed since the previous examination. The heart and mediastinal structures are still drawn to the left. Erect posture.

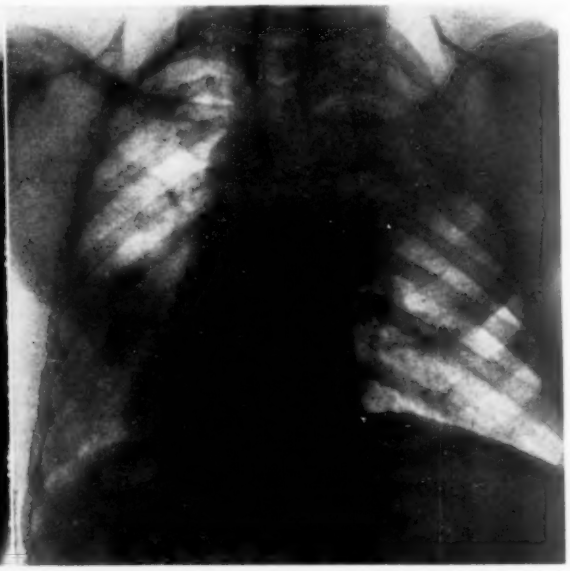

FIG. 9. Case III. Friedländer's pneumonia, second or pseudo-lobar stage. Erect posture.

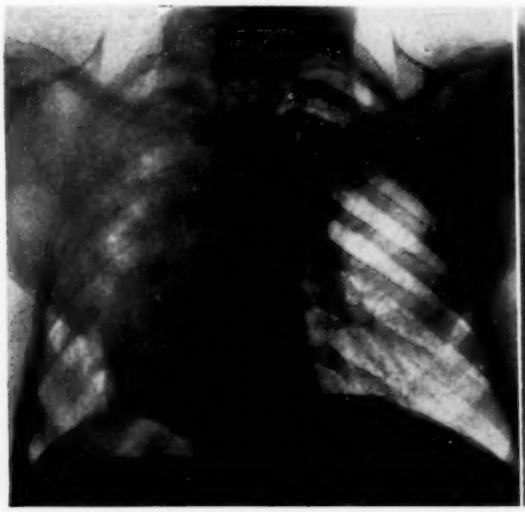

FIG. 10. Case III. Friedländer's pneumonia. The lesion in the left upper lobe is illustrative of the third stage of the disease, while that in the right upper lobe has advanced to the fourth or fibrotic stage. The involvement of the left lower lobe has entirely disappeared. Note the close resemblance to a tuberculous pneumonia as indicated in the text. Erect posture.

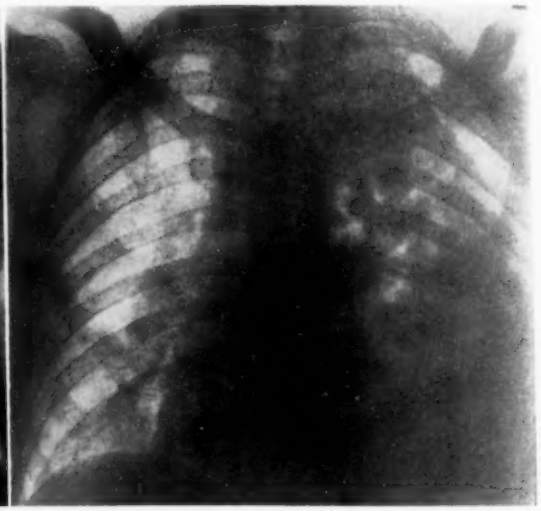

FIG. 11. Case IV. Friedländer's pneumonia, fatal case. This shows the third and most typical stage of the disease, that of multiple abscess formation. Bedside examination.

as shown in Figure 9. This is essentially the same appearance as on admission. During the

characteristic multiple abscesses, as shown in Figure 10. It will be noted that in the left upper lobe we have the third stage of a Friedländer's pneumonia while the lesion in the right upper

lobe which has undergone fibrosis represents the fourth or healing stage. Attention is also called to the fact that the involvement of the left lower lobe which was present on admission has entirely disappeared leaving no evidence of its existence. This examination was made on May 2, two months after the onset of the illness. At this time the patient had a normal temperature, was without symptoms with the exception of weakness and had been about the ward for three weeks in spite of the extensive involvement as shown by the roentgenogram. Three days later he was discharged. We have not been able to follow this patient although we understand he is living and apparently well. Attention is called to Figure 10, an appearance which might readily be mistaken for a tuberculous pneumonia.

Figure 11 is a roentgenogram of the fatal case of Friedländer's pneumonia already referred to. It was made on the twentieth day of the patient's illness and represents roentgenologically the third and most characteristic stage of the disease, namely the stage of multiple abscess formation. This patient died two days later.

ROENTGEN-RAY DIAGNOSIS

From a study of these cases we have been able to follow roentgenologically the various phases that are pathologically characteristic of the disease. Thus we see that in the initial stage there is the roentgen-ray appearance of bronchopneumonia. This differs from the ordinary bronchopneumonia in that it seldom has the typical bilateral distribution with the predominant basal lesions. A single area may be involved which may be limited to a single lobe or embrace several lobes. At other times there may be several areas in the same lung or one or more areas in each lung. Another feature is that the involvement is most marked in the periphery, indicating that the infection is primarily a parenchymal one.

Following closely on this initial stage we have the second stage of the disease in which there is a coalescence of the pneumonic lobules to form larger areas. This appearance closely resembles a lobar pneumonia. The distribution, however, of the consolidations does not as a rule follow the anatomical markings of the lobes as observed in croupous pneumonia. Pneumococcic pneumonia is further distinguished from a Friedländer pneumonia in the manner in which both consolidation and resolution occur. In true lobar pneumonia we have a massive consolidation usually starting in the periphery and progressing toward the hilum. Resolution then occurs in the same manner from periphery to hilum. Friedländer's pneumonia, on the other hand, while it is primarily a parenchymal lesion starts as a bronchopneumonia and only later assumes a lobar appearance. Resolution differs in that it starts at the hilum and progresses peripherally. When this pseudolobar appearance manifests itself there is a fairly rapid resolution occurring in the remainder of the involved lung. These pneumonic areas tend to become smaller and denser. They vary considerably in size ranging in patches characteristic of lobular pneumonia to areas that may nearly involve an entire lobe.

After a variable length of time many of these densely consolidated areas develop into abscesses in some of which it is quite often possible to demonstrate fluid levels. For this purpose a lateral view of the chest is often of great value. The appearance at this time constitutes the third stage of the disease and the one possessing the most diagnostic value roentgenologically. Since the disease is one which usually proves fatal in a short time it is only the exceptional case that can be followed through the three stages enumerated. But with a typical third stage appearance it is possible to make the diagnosis from even a single examination. Three of the 4 cases studied by us were correctly diagnosed roentgenologically without a knowledge of the bacteriological findings.

In those cases that recover it is only natural that the various stages consume a much longer period of time for their development. Such cases offer the best opportunity for study. Following survival of the third stage the process gradually assumes a chronic nature. An irregular fibrosis occurs with cavities remaining at the site of the previous abscesses. These cavities are characteristically thin walled and sometimes difficult to detect. During this recovery period re-infections may occur, the same or new areas becoming

involved and passing through essentially the same stages as in the beginning. Months after apparent recovery marked fibrosis may persist. This may at times be sufficient to cause a retraction of the heart and mediastinal structures toward the affected side with an elevation of the dome of the diaphragm on that side.

COMMENT

In addition to the usual forms of lobar and bronchopneumonia there are two other conditions from which Friedländer's pneumonia must be differentiated, namely influenzal pneumonia and tuberculosis. These are the two conditions with which it is most likely to be confused. There is a close resemblance between influenzal and Friedländer's pneumonia. Both are often rapidly fatal. They start as a primary bronchopneumonia which later develops into a pseudo-lobar pneumonia. Frequently more than one lobe is involved and there is a tendency in both for successive involvement of various portions of the lungs. Occasionally influenza produces chronic abscess formation leading to an overgrowth of fibrous tissue. Influenzal pneumonia differs, however, in that it starts as an intense congestion of the trachea and bronchi with the roentgen-ray changes first appearing at the hilus and spreading peripherally. This is in contradistinction to the parenchymal involvement of Friedländer's pneumonia. Furthermore, we do not see the marked hemorrhagic tendency with its characteristic roentgen-ray appearance as in the cases described by Selby[3] during the influenza epidemic. In the absence of a fatal infection or of complications, influenzal pneumonia shows a tendency to undergo rapid resolution usually within two weeks. The differentiation, however, is by no means a simple one. A case we have recently studied well illustrates this point. A young man suffering from pneumonia, had a roentgenogram very suggestive of a Friedländer's pneumonia and since the clinical course was also in line with such a diagnosis this possibility was suggested to the clinician. A thorough search was made for the encapsulated bacillus, with negative results. Bacteriological studies of the tissues at autopsy proved the infection to be due to the influenza bacillus. On sectioning the lungs numerous abscesses and cavities were found as shown in the roentgenograms. In this connection it is well to mention that Friedländer's pneumonia is almost exclusively found in individuals past middle age.

To the roentgenologist, the most important aspect of Friedländer's pneumonia is its close resemblance to pulmonary tuberculosis. Clinically the two diseases are so much alike that many of the cases reported in the literature were diagnosed tuberculosis and the true nature of the disease only recognized at necropsy. In a chronic Friedländer infection the history of frequent attacks of colds with hemoptysis, general weakness and loss of weight leads to a suspicion of tuberculosis. The physical signs will, as a rule, tend to confirm this suspicion. Here the roentgen-ray examination may be of the utmost value. *Bacillus mucosus capsulatus* appears to show no predilection for any part of the lung and is probably as often found in the lower as in the upper lobes. In tuberculosis, even in the presence of marked fibrosis, there are frequently certain areas of more recent involvement. This is not the case in a Friedländer infection unless the patient is recovering from an acute exacerbation. The cavities found in a Friedländer infection are characteristically thin walled and are such from the beginning, while in tuberculosis this feature usually occurs only in the fairly chronic cavities and at times, regardless of age, cavities continue to possess well-marked outlines. Should the process be confined exclusively to the upper lobes, differentiation by the roentgen ray may be impossible. This is also true in cases of acute exacerbations in the course of a chronic Friedländer infection involving an upper lobe where the resemblance to tuberculous pneumonia may be such that the roentgen-ray examination may be of no material aid in differentiation. In such cases by the law of probability the diagnosis of tuberculosis is justifiable, but one should bear in mind the possibility of a Friedländer pneumonia and report such a possibility to the clinician. A thorough bacteriological study should be made and until the tubercle bacillus is found a

Friedländer infection cannot be definitely excluded.

We have a growing belief that pulmonary infections with *Bacillus mucosus capsulatus* are more common than is generally realized. Certainly the close resemblance of this disease to tuberculosis is highly important and we have the feeling that many cases of Friedländer infection are masking under the diagnosis of tuberculosis. The suggestion has also been made that possibly the numerous cases of bronchiectasis that have come to our attention within recent years may be the end-results of former Friedländer infections. Roentgen-ray examination, we believe, offers considerable aid in the differentiation of this disease from tuberculosis and other pulmonary infections.

SUMMARY

1. Friedländer's pneumonia presents a characteristic roentgen-ray appearance.

2. Four stages of the disease may be recognized roentgenologically: (*a*) the stage of bronchopneumonia; (*b*) the stage of pseudo-lobar pneumonia; (*c*) the stage of multiple abscess and cavity formation, and (*d*) the healing stage or stage of fibrosis.

3. There is also a chronic form of pulmonary infection due to the Friedländer bacillus.

4. Friedländer infection of the lungs must be differentiated from bronchopneumonia, pneumococci lobar pneumonia, influenza and tuberculosis.

5. This form of pulmonary disease is probably more common than is generally supposed.

6. The fibrosis resulting from a Friedländer's pneumonia may be responsible for certain cases of bronchiectasis for which no other cause can be found.

7. Certain cases of supposed chronic pulmonary tuberculosis in which the tubercle bacilli have never been found in the sputum may be, in reality, chronic forms of Friedländer infection.

The author desires to acknowledge his indebtedness to Drs. Pancoast and Pendergrass of the Department of Roentgenology of the University of Pennsylvania Hospital for their generous and stimulating aid in the preparation of this paper.

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THE ROENTGENOGRAM IN MASTOID DISEASE

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BEFORE proceeding to the discussion of the interpretation of roentgenograms of the mastoid process, it is essential to stress the fact that all roentgenographic examinations are only a part of a more complete general examination. The roentgen ray is only a physical agent, capable of being controlled. When properly controlled it will record accurately variations in densities of structures.

The roentgenogram has an established place in otologic diagnosis. The clinician in employing this agent in his practice should not expect a clinical diagnosis from the roentgenologist, nor should he desire any information as to whether or not an operative procedure is indicated. He should expect to derive only the following information, viz., anatomy and pathological variations from the accepted normal. This paper will deal with the essential features of mastoid roentgenography, in conjunction with clinical and operative findings.

ANATOMY

A roentgenogram of the mastoid process reveals the following anatomical landmarks (Fig. 1, a and b):

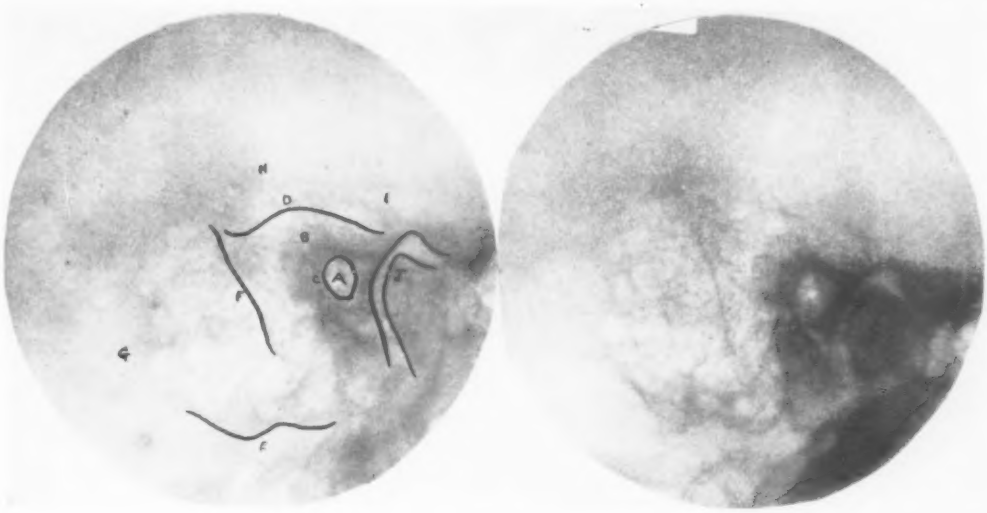
1. Size of the mastoid process.
   - *a.* Small or large.
   - *b.* Extent of cellular development, extension into zygoma, squamosa, occipital bone or petrosa.
2. Character of the structure.
   - *a.* Small pneumatic cells.
   - *b.* Large pneumatic cells.
   - *c.* Small and large pneumatic cells.
   - *d.* Diploetic type.
   - *e.* Sclerotic type.
   - *f.* Undeveloped type.
   - *g.* A combination of any of the above.
3. Internal and external auditory meati.
4. Region of the mastoid antrum.
5. Posterior canal wall.
6. Tegmen tympani and mastoidei.
7. Tip of mastoid.
8. Lateral sinus wall.
9. Mastoid emissary vein.

From a roentgenographic standpoint the mastoid processes in any one individual are usually similar in size and structure. There are a few exceptions to this.

As a rule, the size of the mastoid as determined in a roentgenogram is of little value to the clinician. It becomes important, however, in those cases of protracted acute purulent otitis media, where, in spite of the absence of all systemic and local symptoms, the otological picture is that of an acute mastoiditis. In such a case the finding of an extensive cellularization, toward either the squamosa, zygoma, occipital bone or petrosa, or all these regions, informs the otologist that an extensive destruction must take place before the local and general symptoms are manifested clinically (Fig. 2). On the other hand, a small-sized mastoid process as seen on the roentgenogram will warn the otologist of the possibility of an erosion of the inner table, if operation is delayed too long in a protracted case.

As stated above, the mastoid processes in an individual are usually of the same size and type. Consequently, in a pneumatic mastoid we would expect to find the same cellular development and distribution in both mastoids. However, the size and position of the cells are of importance only in a comparative way. Where, in one area of the uninvolved mastoid one finds small cells, and where in the same area in the involved mastoid large cells are present, it is significant of a destruction of the intercellular septa in this location, resulting in the formation of large cells from the coalescence of smaller ones (Fig. 2).

In considering the diploetic type of mastoid, it is well to include both the sclerotic and undeveloped, since from a roentgenographic standpoint very little distinction can be made between them. They all present a more or less homogeneous shadow, and at times a porous appearance. The undeveloped type and the diploetic type are the result of a failure in pneumatization. The sclerotic type, on the other hand, is the result of new bone deposit replacing and obliterating pre-



a b

Fig. 1. a. Schematic. A. Internal and external auditory meati (superimposed). B. Mastoid antrum. C. Posterior canal wall. D. Tegmen tympani and mastoidei. E. Tip of mastoid. F. Lateral sinus wall. G. Occipital cells. H. Squamous cells. I. Zygoma cells. J. Temporomaxillary articulation.
b. Roentgenogram.

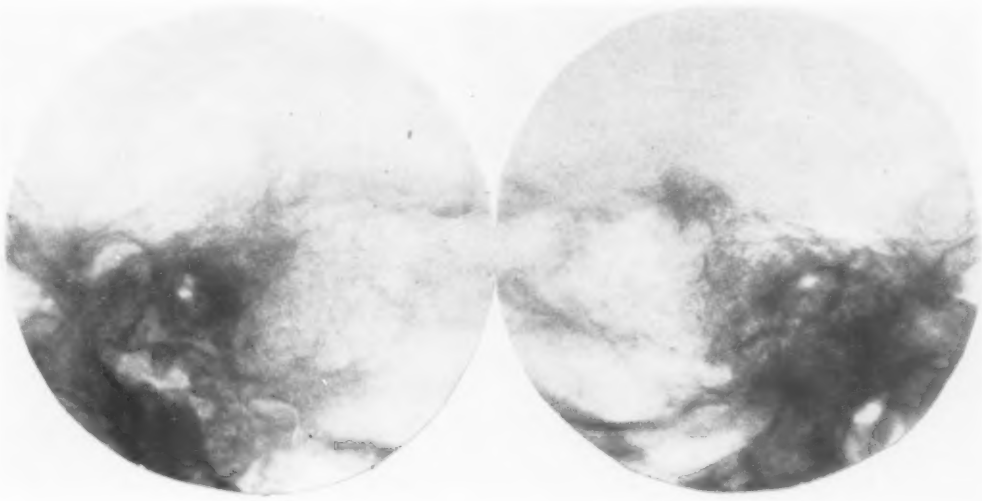


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Fig. 2. Left. Normal. Right. Extreme cellularization into zygoma, squamosa, occipital and petrous portion of temporal bone. Composed of small and large pneumatic cells. Diminished illumination throughout, most marked in antrum region and towards tegmen. Considerable destruction of intercellular walls with thinning of cell walls in part. Sinus wall prominent, regular and occupying a median position. Coalescence of small cells.

Clinical. Right aural discharge for four weeks. Sagging superior canal wall. Pulsating discharge. No systemic symptoms. No pain.

Operation. Very large mastoid, extensive destruction, intact cells containing pus in squamosa and occipital bone. Pus and granulations in mastoid cavity proper.

viously existing cells. As above stated, the differentiation of these three types is sometimes difficult.

In a properly taken roentgenogram of the mastoid the internal and external auditory meati are superimposed. Their only significance is in determining the position of the mastoid antrum, which on a roentgen film is located above and slightly posteriorly (Fig. 1). The mastoid antrum in a normal person cannot, as a rule, be identified as an individual cell,

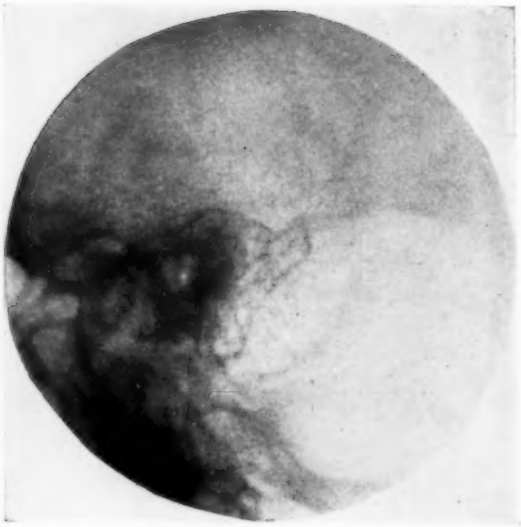

Fig. 3. Sinus wall situated well forward (Fig. 1, median position; Fig. 5, left, posterior position).

for it is overshadowed by smaller cells nearer the cortex. It is in this region that the first changes of an acute mastoiditis become evident.

The posterior canal wall can be seen as a distinct wall bounding the posterior aspect of the auditory canal. When viewed from the mastoid side it is merged with the dense petrous portion of the temporal bone.

The tip of the mastoid is always evident on the mastoid plate. It appears as a more or less sharp line demarcating it from the superimposed occipital bone.

The lateral sinus usually can be seen throughout its entire longitudinal and sigmoid portions. The sinus may be situated anteriorly (i.e., close to the posterior canal wall), posteriorly or in a median position (Figs. 3, 1, and 5 left). Its location in relation to the posterior canal wall is of importance to the surgeon in affording him a guide as to its position within the mastoid. The sinuses which we have found situated well forward on a roentgen plate, were found at operation to be superficial as well. In the undeveloped type of mastoid the sinus is usually forward.

The mastoid emissary vein is usually situated midway between the tip of the mastoid and the knee of the sinus. The location of this vein is of importance (Fig. 10) to the surgeon, so as to avoid accidental injury and unnecessary bleeding during operation.

The foregoing pertains to the adult type of mastoid. In children under three years of age a roentgenogram of the mastoid process will yield practically no information, because pneumatization has not taken place to any extent. Between the ages of three and five some information can be obtained because at this time the

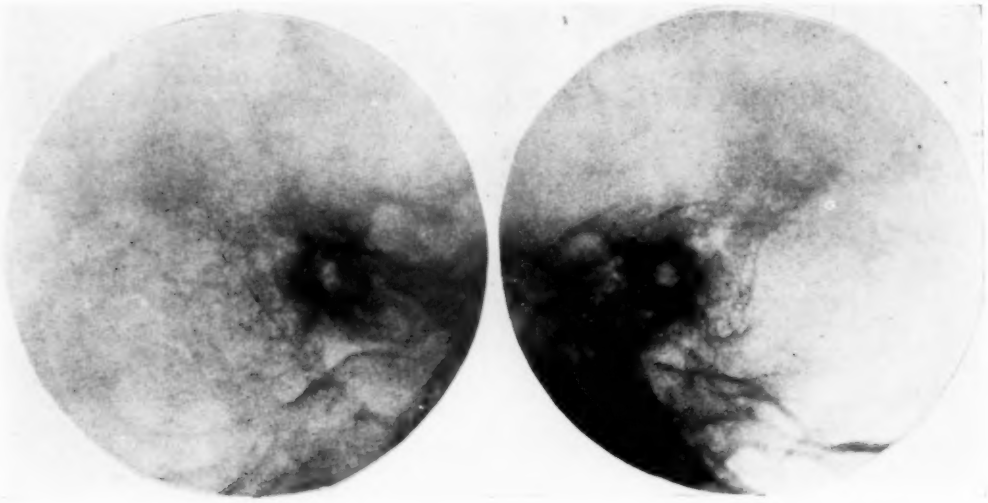

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Fig. 4. Left. Normal. Right. Slight diminution in illumination when compared to healthy side. Intact intercellular walls. Clinical. Acute purulent otitis media. Cleared up.

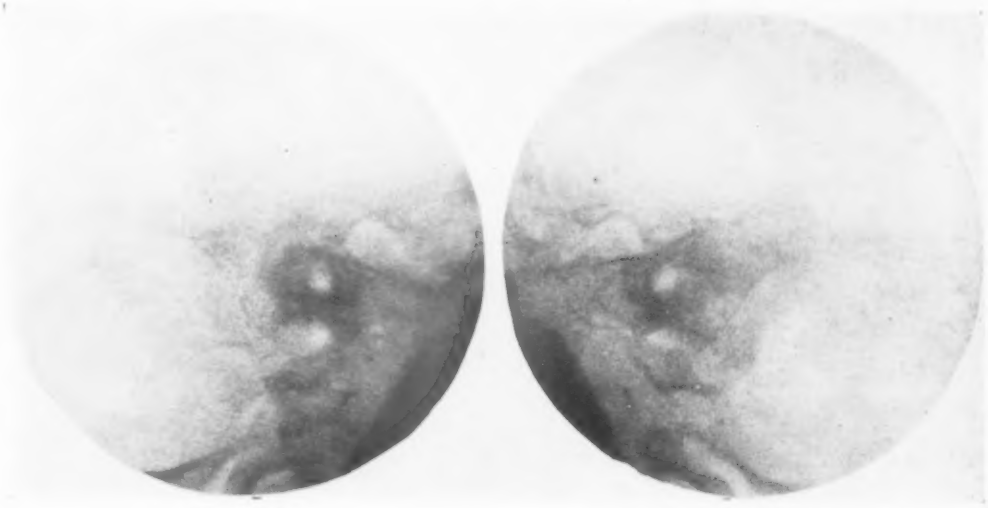

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FIG. 5. Right. Diminution in illumination. No cellular destruction. Left. Total destruction of cells except over lower portion of sinus and tegmen, where cells are intact and walls are thin. Sinus wall situated posteriorly. Sinus wall and tegmen intact. Operation. Left, acute coalescent mastoiditis.

mastoid begins to assume the adult form. Very frequently we find a fully developed mastoid at the age of three.

PATHOLOGICAL CHANGES

General Pathology. The following are to be looked for in a roentgenographic examination of a diseased mastoid:

1. Variations in density.
2. Absorption of bony trabeculae.
3. Erosions of the tegmen and sinus wall.

In a normal mastoid the cell walls stand out as definite shadows. The air spaces offer little resistance to the rays and appear in the roentgenogram as illuminated areas separated by the shadows of the cell walls. Anything in the locality of the mastoid which offers added resistance to the rays will decrease the illumination of the air spaces. However, it may not obliterate the intercellular septa.

Since the variations in density are dependent upon increased resistance to the rays, it becomes evident that such conditions as furunculosis of the external auditory canal, with its accompanying edema, postauricular glands or cellulitis decrease the normal illumination. The diminution in illumination which is produced by the above-mentioned conditions is also noted in any involvement of the middle ear in an acute inflammation. The latter produces a contiguous hyperemia or edema within the mastoid process. Roentgenographically, the etiological factors producing a mild diminution in illumination cannot be differentiated.

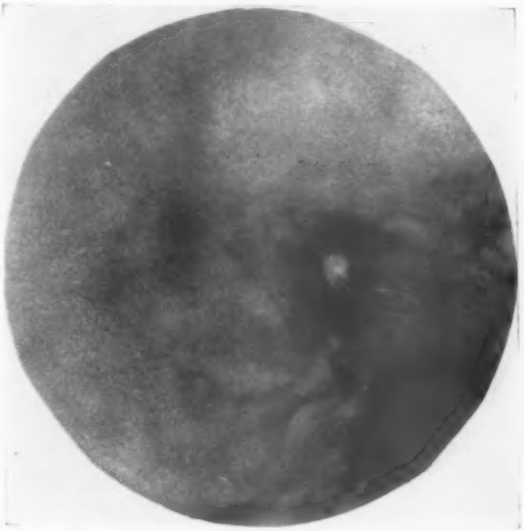

FIG. 6. Thinning of septa with a localized area of destruction. Clinical. Acute exacerbation of a chronic otitic infection. Cleared up without operation.

Where a marked diminution in illumination or marked clouding of the mastoid process is noted, an exudate and granula-

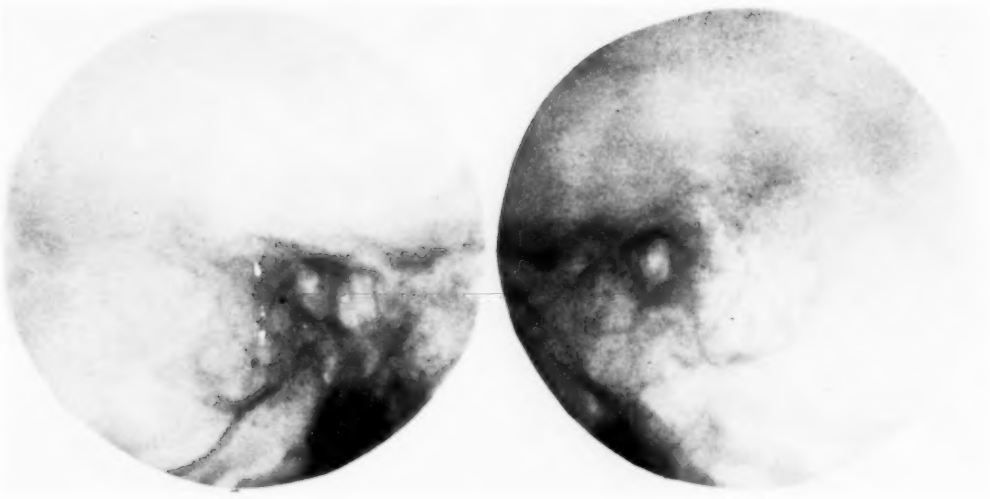

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FIG. 7. Left. Normal. Right. Complete coalescence of all cells, except for a few cells over the knee and sigmoid portions of the sinus. Tegmen and sinus wall intact. Operation. Acute coalescent mastoiditis. Pus and granulations in mastoid cavity. Perisinal cells intact, containing pus.

tions are present within the mastoid. A marked diminution in illumination can also be produced by new bone formation within the mastoid, as is present in a the mastoid (Fig. 10). Changes in density do not necessarily have to involve the entire mastoid process, but may be found in localized areas within it.

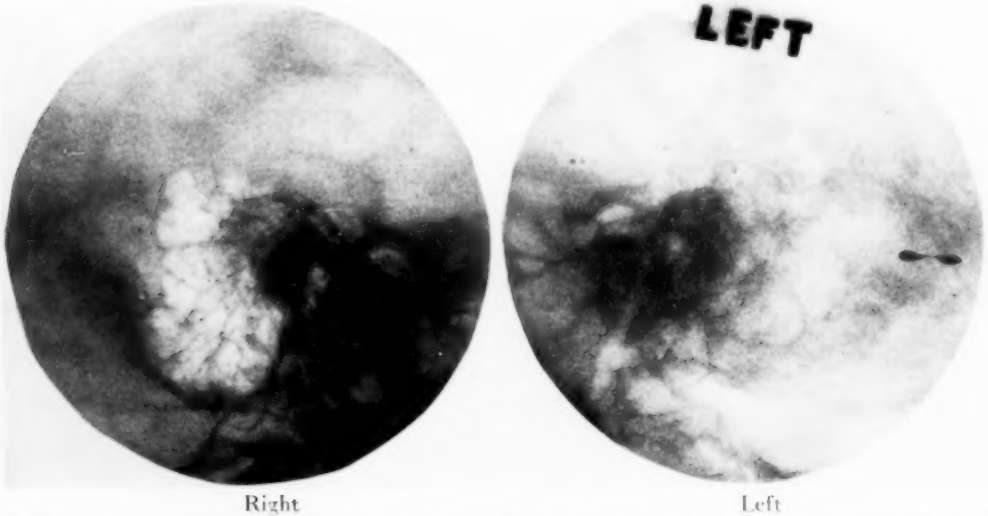

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FIG. 8. Right. Normal. Left. Localized areas of cellular destruction due to previous attacks of acute otitic infection. Clinical. Repeated attacks of acute otitic infection, which cleared up without operation. (Roentgenographic examination during an acute attack.)

sclerosis. The differentiation between these two conditions can be made, roentgenographically, very often. As a rule, the bony portion of the eustachian tube is involved in a change similar to the sclerosis within

Thinning, absorption or destruction of intercellular septa can only be the result of a pathological process within the mastoid bone.

Where the pathological process within

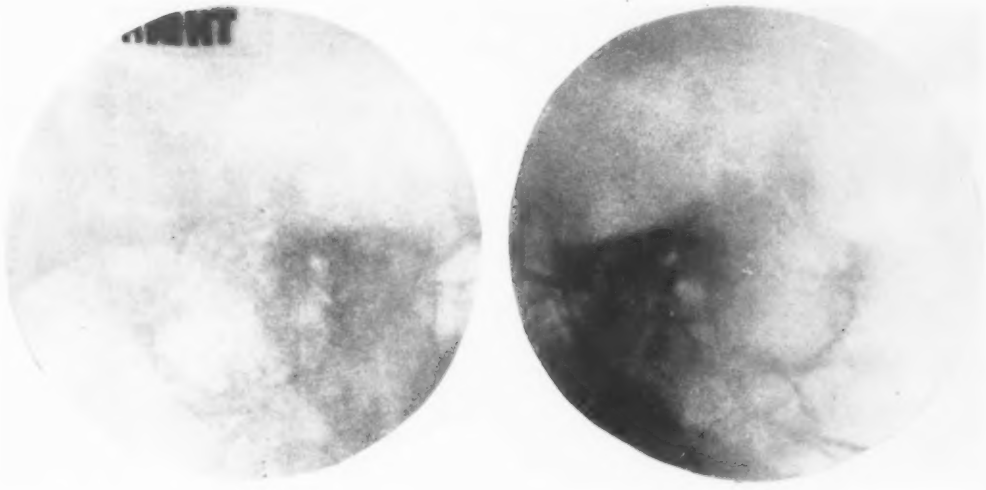

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FIG. 9. Right. Normal. Left. Coalescent mastoid. Solution in continuity of sinus wall at knee and at region of tegmen mastoidei. Operation. Coalescent mastoiditis. Perisinal abscess. Epidural abscess.

the mastoid has extended to and involved the inner table, we at times see a solution in continuity of the sinus wall, or changes in density in the region of the tegmen. density alone. As previously set forth, only intramastoidal diseases will cause a partial or total destruction of the intercellular structure. Bearing this in mind,

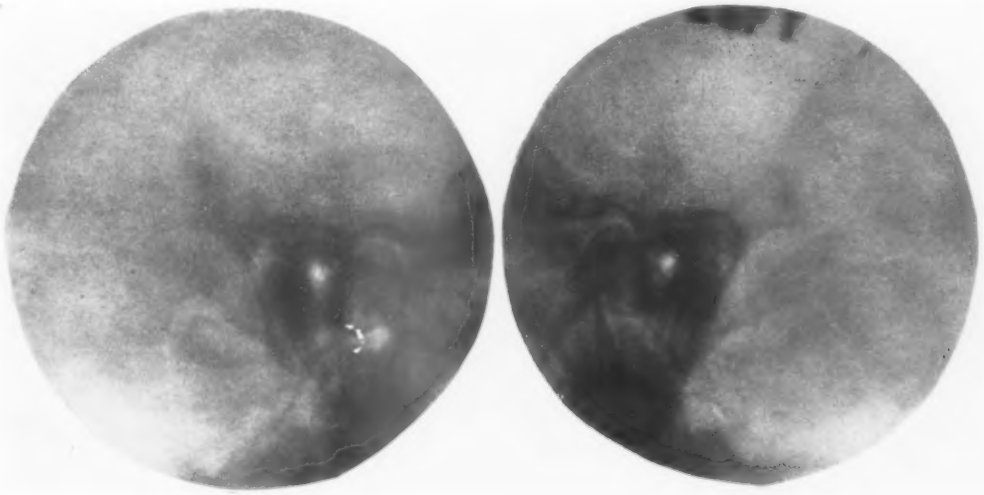

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FIG. 10. Partially sclerotic mastoids. Cells present in angle between sinus and tegmen, and in zygoma. Right shows mastoid emissary vein. Both show bony portion of eustachian tube. Clinical. Chronic purulent otitis media for many years.

Special Pathology. Acute Otitic Infections. All acute otitic infections, regardless of their type or location, will produce a decrease in illumination when compared with the healthy side. Consequently one cannot base an opinion on a variation in the classification of mastoid diseases from a roentgen-ray standpoint into those which destroy structure and those which do not, becomes evident.

Non-destructive. A slight diminution in illumination of the mastoid process,

FIG. 11. Complete sclerosis of the mastoid. Bony portion of eustachian tube visualized. Clinical. Chronic purulent otitis media for many years.

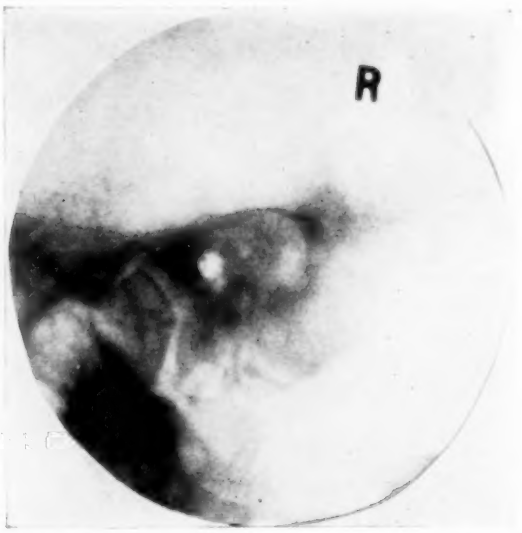

FIG. 12. Large area of destruction in antrum region surrounded by dense bone. Cholesteatoma. Clinical. Intermittent discharge from right ear for seven years. Sudden attack of vertigo and falling to left. Fistula test positive in right ear. Operation. Large cholesteatoma which had destroyed entire posterior canal wall. Facial nerve exposed by cholesteatoma and granulations over horizontal canal.

with intercellular walls and all other anatomical landmarks intact, will be found in the following conditions:

1. Furunculosis.
2. Postauricular adenitis.

purulent otitis media involves the mastoid process in a hyperemia or edema. To say

FIG. 13. Postoperative, simple mastoidectomy. Cells remaining anterior to sinus wall, in zygoma and squamosa. Clinical. Two prior simple mastoidectomies for persistent discharge from postauricular wound.

FIG. 14. Osteoma, arising from cortex at superior posterior portion of mastoid process.

3. Cellulitis.
4. Acute purulent otitis media.

It is an established fact that every acute

just when an acute purulent otitis media becomes an acute mastoiditis, must be left to the otologist. From a roentgenographic standpoint, when we find some diminution in illumination of the mastoid

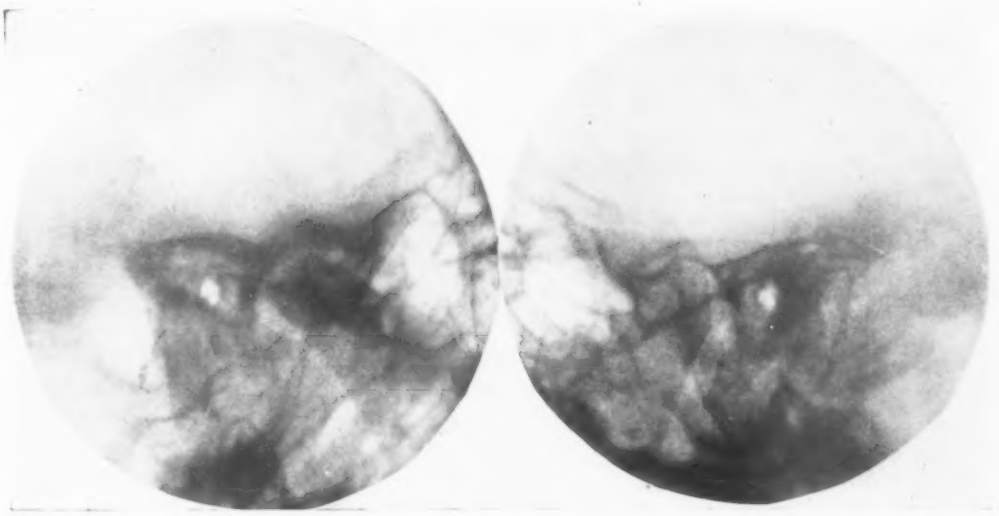

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FIG. 15. Arthritis of temporomaxillary articulation, right side. Clinical. Radical mastoidectomy followed by pain in front of ear and limitation of motion of mandible.

process, with intact cellular walls, we do not know whether it is due to an acute purulent otitis media or an early acute mastoiditis of a surgical nature (Fig. 4).

There is one type of acute mastoiditis wherein the cell walls always remain intact. In the acute hemorrhagic mastoiditis there is found only a diminution in illumination. The cell walls remain intact throughout the entire course of the disease.

Destructive. When the mastoid becomes involved in a purulent process, definite destructive changes can be detected in a roentgenogram. As the disease progresses from the middle ear through the antrum and into the mastoid process, the diminution in illumination becomes more marked. With increased pressure of the encapsulated pus against individual bony trabeculae, the blood supply is shut off and a necrosis, and finally a destruction, result. In a mastoid process wherein the septa are of moderate thickness we can detect the early destructive changes by a thinning of the walls (Fig. 5). With a further increase in pressure the septa are destroyed. When this occurs, several small cells break down and form a large cavity (Fig. 6). If the process continues far enough most or all of the septa are destroyed, and we have a large abscess or a coalescent mastoiditis (Figs. 7 and 9).

If a case is studied by a series of roentgenograms over a period of time, this progression and destruction of septa are easily demonstrated. If the progression of cellular destruction increases on successive plates, it is indicative of an active lesion within the mastoid process. On the other hand, should the roentgenogram reveal a cessation in the absorption of the bony trabeculae, they inform the otologist either that the activity of the lesion is subsiding or that the disease is in abeyance for the time being (Fig. 5, right). Naturally, these findings must be borne out by the clinical picture.

In a patient who has had an acute mastoiditis which has subsided, an area of destruction may be noted on a subsequent examination, corresponding to the area involved in the original lesion (Figs. 6 and 8). If this patient should again be roentgenographed during a subsequent attack of acute otitis media or mastoiditis, due consideration must be given to the area of destruction noted within the mastoid process from the earlier attack. This area of destruction may have no bearing on the present lesion. In such cases, repeated roentgenograms are essential to follow the progress of the disease.

In a normal mastoid process the lateral sinus does not show very distinctly. This is due to the fact that the mastoid cells and the blood content of the sinus are of

about the same density. When the mastoid becomes involved, the sinus wall usually appears very prominent, due to the change in density of the mastoid cells. Consequently, when on comparing both sides the sinus wall appears more prominent on one side, it is significant of an involvement of that side (Fig. 2).

The sinus wall should be carefully inspected for any solution in continuity, for this indicates a perisinal lesion. The tegmen should be inspected for the same reason, as an epidural abscess may be detected in this manner (Fig. 9).

Chronic Otitic Infections. All chronic otitic infections will produce a more or less marked eburnation within the mastoid process. This eburnation or sclerosis can be seen in the roentgenogram as a dense shadow with no cellular structure (Figs. 10 and 11). It is termed a productive change and may involve part or all of the mastoid process. The finding of a sclerosis of the mastoid process in the roentgenogram is not, *per se*, an indication for operation. A chronic purulency due to bone necrosis and one not due to bone necrosis can produce the same sclerotic lesion. The operative indications can only be determined clinically.

As previously stated, differentiation between the density of a sclerotic mastoid and that of some cases of acute coalescent mastoiditis is furthered by the visualization of the bony portion of the eustachian tube in the former type.

That type of chronic purulent otitis media known as cholesteatoma will result in destructive changes in the mastoid process in addition to the productive ones. The productive change is seen as a dense linear shadow surrounding the destructive area produced by the cholesteatoma, which by comparison appears as an area of increased illumination (Fig. 12).

Postoperative Mastoids. In an operative mastoid, no cellular structures are demonstrated: the operative field is clearly visible, demarcated by the sharp linear shadows of the tegmen and the sinus.

The necessity for roentgenographing postoperative cases arises only when reinfection of the mastoid occurs or when a wound presents a persistent discharge. If any cells were not removed at the time of the primary operation they will be demonstrated on a flat plate (Fig. 13). For a more detailed examination, stereoscopic plates should be taken, particularly when a sequestrum is suspected.

Miscellaneous Conditions. New growths in the vicinity of the mastoid may at times puzzle the clinician as to their origin. A roentgenogram will determine the site of origin and the character of the growth (Fig. 14).

Where, following a mastoidectomy, pain in front of the ear is complained of, a roentgenogram should be taken to exclude involvement of the temporomaxillary articulation. In an extensive zygomatic cellularization, surgery may at times accidentally open the joint to infection from the zygomatic cells. This may also happen in too closely shaving the anterior canal wall during a radical mastoid operation (Fig. 15).

SUMMARY

1. Mastoid roentgenography is an aid to otologic diagnosis. It should not overweigh the clinical findings.

2. A roentgenogram of the mastoid should give the following information:

a. Anatomical data.

b. Variations in density.

c. Absence or presence of a destructive lesion.

d. Absence or presence of a productive lesion.

3. A history of a previous acute otitic infection must be taken into consideration when estimating the significance of a localized area of destruction on a roentgenogram.

4. A mastoiditis which shows only a mild involvement, as evidenced by decreased illumination and slight destructive changes, may clear up without operative intervention. A progression of destructive changes in an acute otitic infection indicates that the lesion is active.

5. The finding of a sclerotic mastoid is in itself no indication for operation.

6. The clinical findings should furnish the chief guide to procedure.

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CONGENITAL ABSENCE OF THE FEMUR, PATELLA, TARSAL SCAPHOID, AND ISCHIUM ASSOCIATED WITH OTHER ABNORMALITIES*

CASE REPORT

BY A. R. SHANDS, JR., M.D.

WASHINGTON, D. C.

CONGENITAL anomalies are all relatively uncommon and will always possess an unusual interest. If the abnormal were not carefully observed, the characteristics of the normal would often be overlooked. This case presents so many striking abnormities, that it is difficult to decide which are the most significant. It is thought that the absence of the right thigh and femur is the most important, hence emphasis in the report is placed on this finding. The case report is as follows:

CASE REPORT

Date. December 18, 1927.

Patient. J. B., white, male, unmarried, aged twenty-three.

Complaint. Absence of the right thigh and inability to use the left leg.

Family History. Father and mother alive and well. Six brothers and 2 sisters alive and well. No congenital abnormalities in the family. No tuberculosis, cancer, insanity, heart or kidney disease.

Past History. General health excellent. Diseases. Diphtheria at age of nine; chicken-pox and whooping cough at twelve; mumps at thirteen; measles at twenty; influenza at fourteen, again at fifteen, again at sixteen.

Operations and Accidents. None before present illness.

Head and Neck. No sore throats, two extractions in 1925.

Cardio-respiratory. Seldom has colds. No cough, and no hemoptysis.

Gastrointestinal. Bowels irregular. Appetite good.

Genitourinary. Denies all venereal disease. No intercourse.

Nervous System. Negative.

Bones and Joints. Negative except for present illness.

Habits. Does not use tobacco or alcohol. Occupation has been that of a school teacher.

Present Illness. The patient says that he was born with a short right leg, and that he has never had a thigh or knee joint on this side. Up until twelve years of age he walked with crutches. Since this time he has walked with an artificial wooden leg, which he made himself. He has always been active and does not feel that he has been much handicapped because of his physical deformity.

On Oct. 12, 1926, the patient was in an automobile accident and injured the left leg and knee. The knee was badly cut and bruised and there were pieces of bone projecting through the skin. Apparently this became infected and drained for two months. At this time an operation was performed and a portion of the left patella removed. After the drainage had stopped and the wound healed, he found that upon attempting to bear weight on the leg, the knee would give away and jackknife under him. This is the immediate cause for admission to the hospital.

Physical Examination. General appearance is that of a well-nourished white man of twenty-three, who is well developed except for the right lower extremity. He is lying quietly in bed without pain. Unable to walk because of recent injury to left knee. He is mentally alert and co-operative.

Skin. Soft and dry. Color normal except for pallor in the right lower extremity. Back shows an erythematous, squamous eruption which is irregular in shape and distribution. Pressure over these reddened areas causes them to disappear. There are some areas of increased pigmentation and roughness. This extends over the shoulders, down the middle of the back, and along the spinous processes of the lumbar and sacral vertebrae.

Glands. There are a few small, palpable, slightly tender glands in the left groin and in the left axilla.

Head is of a steeple shape with the apex in the middle of the parietal region. There is a depression in the posterior portion of the sagittal suture, anterior to the posterior fontanelle. It is quadrangular in shape, and measures 2 cm. across its longest diameter. The patient states that when he was a baby this depression was more marked and that he

* From The Orthopedic Department of the Johns Hopkins Hospital, Baltimore, Md.; read before the Medical Society of the District of Columbia, February 15, 1928.

FIG. 1. Anterior view of congenital anomaly. Notice the fullness in the right groin which is a mass of muscle tissue, and the marked pes planus on the right.

wore a cap constantly until he was three years old, which the doctor said was to make his head grow together. The scalp and hair are normal.

Eyes. Narrow palpebral fissures. Slight exophthalmos. Extraocular movements normal. Pupils large, round, equal, and react normally to light and accommodation. Sclerae normal.

Ophthalmoscopic. Optic discs normal. No engorgement of vessels. Examination negative.

Ears. Hearing acute on both sides. No tophi or discharge. Mastoids not tender.

Nose. No obstruction. No deviation of the septum. No tenderness about the frontal or maxillary sinuses.

Teeth. Some evidence of dentistry. Two extractions. One devitalized premolar in the upper right jaw, which has slight tenderness and fullness about the root.

Throat. Tonsils small. Pharynx clear and not injected.

Neck. Thyroid not enlarged. No asymmetry.

Thorax. Muscles unusually well developed.

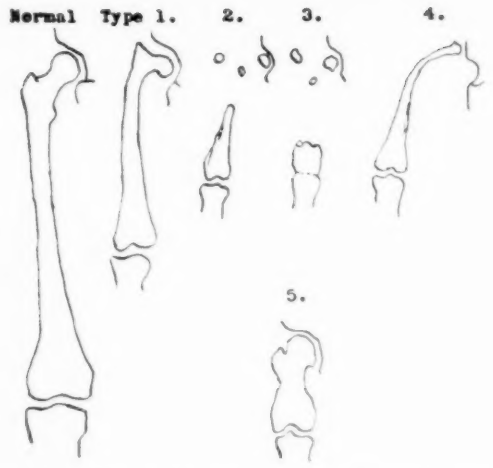

FIG. 2. Sketch of the five types of congenital femoral defects (from Reiner[3]).

Symmetrical. Good respiratory movements. Heart. Note nlarged. Point of maximum impulse in the 5th interspace within the nipple line. Sounds clear and regular in rate and rhythm. No murmurs. Lungs. Normal on percussion and auscultation.

Abdomen. No masses felt. Slight tenderness in the right lower quadrant. Liver dullness to costal margin. Spleen not felt.

Genitalia. Penis of normal size and shape. Testes not palpable. There is a small amount of loose skin about the region where the scrotum should be. The external inguinal rings cannot be definitely made out. There is a small scar on the glans penis. The patient says that this was due to carbolic acid, which was put on several years ago to cure a few small pimples which were present.

Rectal. The prostate is hard, firm, and small, except at further end which seems fluctuant. Prostatic fluid showed many pus cells, singly and in clumps, about 30 to 50 to high power field.

Upper Extremities. All muscles are present and of excellent tone and strength. Bones and joints normal.

Right Lower Extremity. Inspection shows a well-formed foot and lower leg attached to the region of the hip without a thigh intervening. Upon palpation there are two bones in the lower leg, which are taken to be the tibia and fibula. The upper ends of these bones can be felt in the soft tissues opposite the position of the hip with apparently no ligamentous attachments to this side of the pelvis. There is no stable joint present in this region. The active and passive motion of the lower leg in this region is as follows:

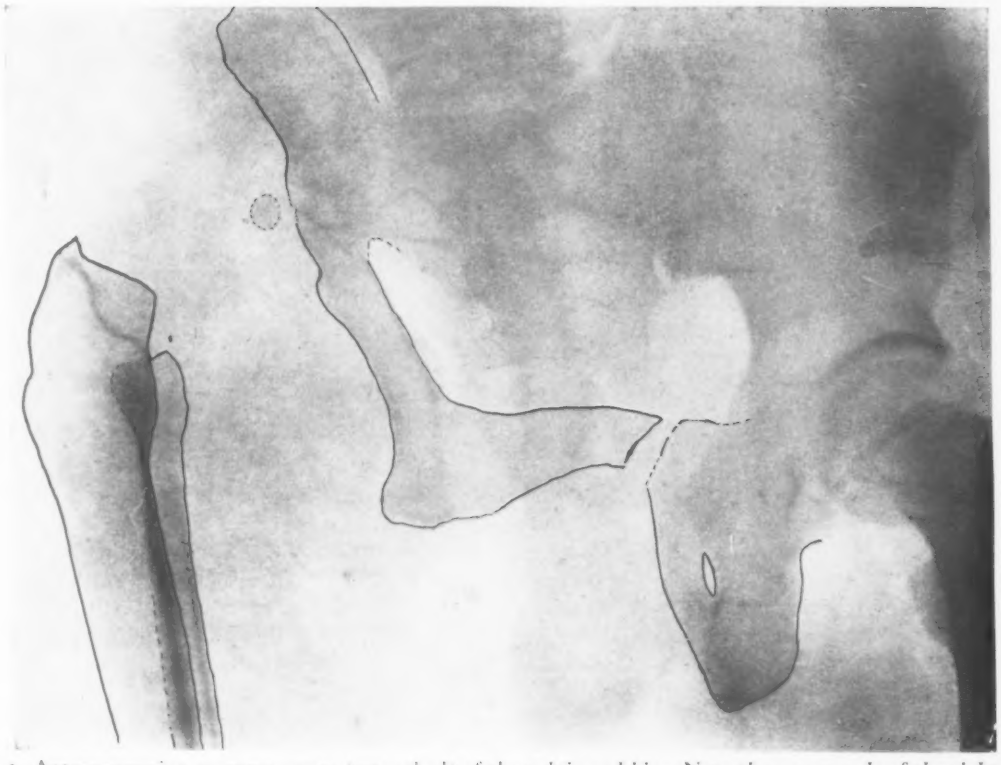

Fig. 3. Anteroposterior roentgenogram (retouched) of the pelvis and hips. Note the upper ends of the right tibia and fibula opposite the head of the left femur, the small nodule of bone opposite where the right acetabulum should be, the imperfect right ilium and pubis and the absence of a right ischium.

Motion—	Flexion	Active 20°	Passive 90°
	Extension	Active 30°	Passive 80°
	Abduction	Active 30°	Passive 30°
	Adduction	Active 45°	Passive 90°
	Internal rotation	Active 30°	Passive 75°
	External rotation	Active 60°	Passive 90°

The anterior superior spine and Poupart's ligament cannot be palpated. The crest of the ilium is much shorter than normal and is felt far posteriorly and laterally. There is a mass in the right groin beneath the position where Poupart's ligament should be, which is well circumscribed, oval in shape, measuring 12 by 8 cm., of a soft doughy consistency, smooth in contour, and apparently containing muscle tissue. There is an atrophy of the foot and calf. The sole of the foot is slightly above the level of the left knee.

Foot. Presents a rather marked valgus and calcaneus deformity with a pes planus. Inversion is definitely limited. All other motion is exaggerated, especially dorsiflexion which is about 20 degrees more than normal. There is a marked increase in the amount of mobility in the mediotarsal joint. There is a relaxation of the Achilles tendon with no loss of strength. There is a weakness in the tibialis posticus. The sensation is normal throughout the foot and leg.

Left Lower Extremity. The hip is normal. The anterior superior spine and iliac crest can be palpated in their normal positions. The knee shows an irregular ragged scar over the region of the patella. The main body of the patella has been removed. The patient is unable to actively extend the lower leg. The quadriceps muscle is normal. Contraction of this muscle elicits a pull upward on a small piece of bone remaining on the medial side in the quadriceps tendon. This tendon is adherent to the scar. The scar is not adherent to the femur. The active flexion of the knee is normal. Any attempt to bear weight on the leg causes the knee to automatically flex. The foot is of normal size and shape. The muscles of the calf are of normal tone and strength.

Back. There is a right lateral curvature of the spine in the lumbar and dorsal regions, which starts at the level of the 9th dorsal vertebra and is most marked at the level of the 2d lumbar. There is an atrophy of the right back especially of the buttock and lumbar region. There is a slight dimpling over the sacrum.

Reflexes. No Babinski on either side. The ankle jerk is exaggerated on the right. There is

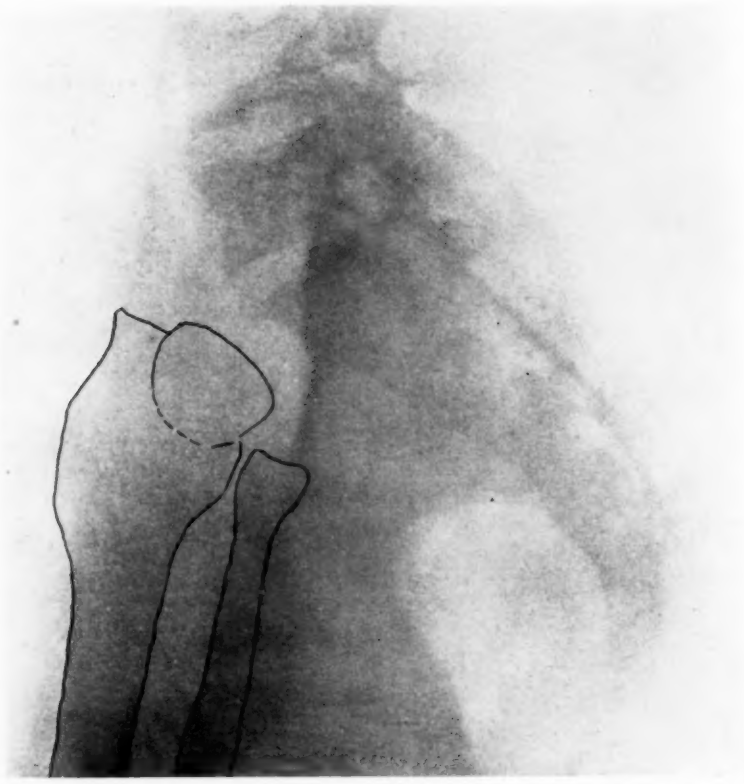

FIG. 4. Lateral roentgenogram (retouched) of the pelvis and hips. Note the large size of the head of the tibia and the circumscribed nodule fused with this, which is taken to be the lower femoral epiphysis.

a suggestion of sustained ankle clonus on the right. No Oppenheim or Gordon. The abdominals are all present, and slightly exaggerated in the lower quadrants especially on the right. The deep reflexes of the arms are normal and equal. The jaw jerk is normal.

Special Examinations:

1. *Neurological.* Cranial nerves function normally. There is no disturbance of motion or sensation in the arms. The right foot is represented by a well-formed facet, which is joined to two long bones, apparently the tibia and fibula, which end in the region of the hip joint without the interposition of a femur. The foot is small, but otherwise normal. The mobility of the toes and ankle is of normal range. The segment above the foot represents a normal leg in the shape of the bones and muscular distribution, but is much shorter. This rudimentary extremity may be moved freely in abduction, adduction, and extension, but flexion is feeble. Sensation is quite normal. The Achilles jerk is active. No changes are observed in the skin. At the hip there is a large soft mass, which is chiefly composed of muscle, but the individual muscles cannot be identified.

2. *Urological.* Genitalia. Penis normal size. No discharges. Scrotum is entirely lacking, and is replaced by loose skin, which can be pulled forward and stretched. Palpation in the groins reveals no testes. Patient says that he has never had intercourse, but has had nocturnal emissions of semen. Has good erections. It is possible that the testes are either so high that they cannot be palpated or are within the abdomen.

Rectal. Anal sphincter of good tone. Rectum negative. Prostate of normal size. Median furrow and notch are present. On the right there is a rather small, firm nodule, which apparently is the seminal vesicle. This is particularly hard, thickened, and cord-like, about the size of the little finger. It is acutely sensitive, and an attempt to strip this meets with remonstrance from the patient. The left seminal vesicle is corded to about the same degree, but slightly less in size. Massage done and prostatic secretion expressed. There was quite an amount, showing much mucus, many lecithin bodies, and quite a few pus cells, 10 to 12 per high power field. Normally active spermatozoa in great numbers.

Impression. Congenital non-descent of the testes; chronic prostatitis, marked degree.

Laboratory Examinations:

1. Urine. Amber color, sp. gr. 1022, reaction acid, albumin and sugar, negative; microscopic shows 5 white blood cells per high power field, mucus shreds; no red blood cells or casts.

2. Blood. White blood cells, 6,840; Hb 105 per cent (Sahli).

3. Blood Wassermann. Negative in both water-bath and ice-box fixations.

4. Blood chemistry.

Non-protein nitrogen	33 mg. per 100 c.c.
Creatinine	1.3 mg. per 100 c.c.
Uric acid	1.9 mg. per 100 c.c.
Sugar	88.0 mg. per 100 c.c.
Calcium	11.4 mg. per 100 c.c.
Phosphorus	Slightly elevated 4.7 mg. per 100 c.c.

5. Kidney functional test (phthalein).

1st hour	60 per cent
2d hour	15
Total	75 per cent

Roentgenological Examinations:

1. Pelvis and Hips. Anteroposterior. There is a complete absence of the right femur. The right side of the pelvis presents the following congenital anomalies: a complete absence of the ischium, an absence of the inferior ramus of the pubis, a small and imperfect ilium, and an absence of the acetabulum. The sacrum on the right is smaller than on the left, and there is an articulation between this and the pubis. Opposite the junction of the right pubis and ilium, there is a small bony nodule, which is thought to be the remains of the caput epiphysis of the femur. The upper ends of the right tibia and fibula are opposite the junction of the pubis and ilium.

Lateral. The upper end of the tibia is unusually broad and long. There is a small round fragment of bone, apparently fused with the shaft of the tibia on the fibula side, which is thought to be the remainder of the lower femoral epiphysis. There is no patella present.

2. Right Foot. There is a congenital absence of the scaphoid. In the anteroposterior view, the head of the astragalus is seen to be unusually broad, and articulates with the three cuneiforms and cuboid. In the lateral view the head and neck of the astragalus do not appear to be unusually long.

3. Skull. There are bony defects along the posterior middle portion of the sagittal suture, which gives the appearance of there being only a partial union between the parietal bones. The anterior and posterior fontanelles are apparently closed. The sella is normal. The skull is of an oxycephalic shape.

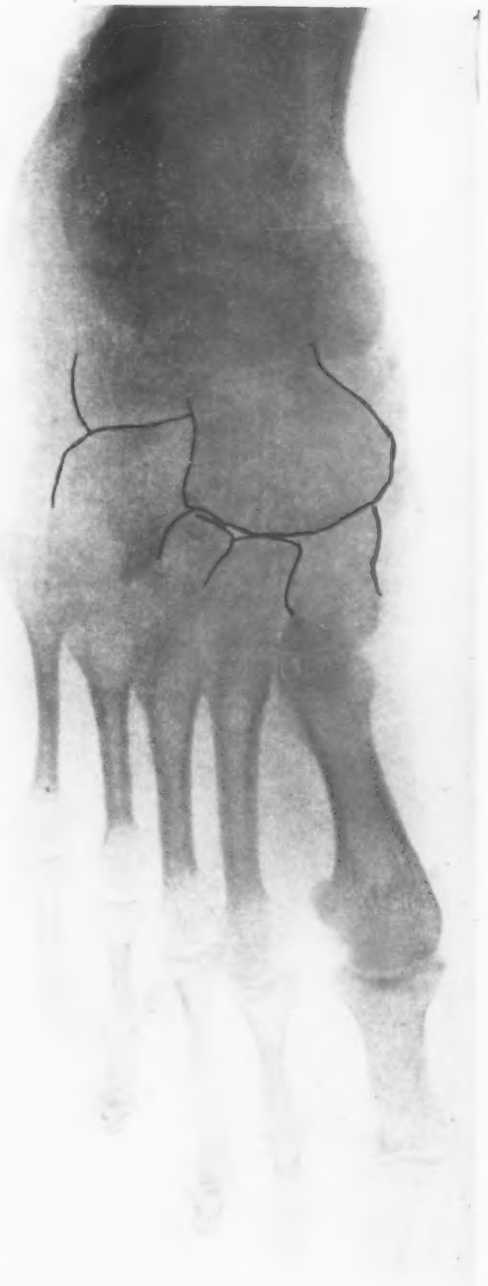

FIG. 5. Anteroposterior roentgenogram (retouched) of the right foot. Note the absence of the scaphoid, the increase in width of the head of the astragalus and its articulation with the three cuneiforms and the cuboid.

Summary of History and Examinations:

History. The patient is a man of twenty-

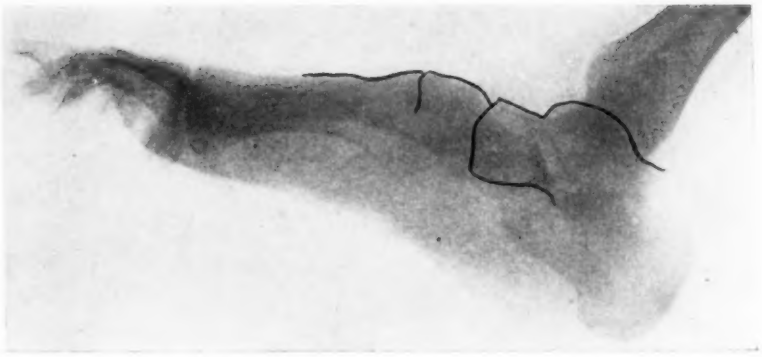

FIG. 6. Lateral roentgenogram (retouched) of the right foot. Note the absence of the scaphoid and normal appearance of the astragalus.

three years, who was born with an absence of the right thigh, and who apparently has been able to walk with an artificial leg until a recent injury to the left knee.

Complete absence of right thigh and knee joint.

Large circumscribed mass of muscle tissue in right groin.

FIG. 7. Lateral roentgenogram of the skull. Note the oxycephalic shape and the congenital defects in the parietal bones.

Examinations. Important positive findings are as follows:

Oxycephalic shape to skull with a depression in the middle portion of the sagittal suture.

Calcaneo-valgus deformity of right foot with unusual mobility of the mediotarsal joint.

Undescended testes with absence of scrotal sac.

Chronic prostatitis with many pus cells in the urine.

Instability of left knee due to injury.

A slightly elevated blood calcium content.

Roentgen-ray examinations as reported above, namely:

Absence of right femur, right ischium, right patella, and right tarsal scaphoid; imperfect right ilium and right pubis; and congenital defects in the skull.

LITERATURE

A review of the literature shows that of the long bones the femur is the fifth most common one affected in congenital abnormalities. The fibula is first, the tibia second, the ulna third and the radius fourth. An insolated defect of the humerus has never been reported; however, it is obviously lacking when the whole extremity is absent or when the hand articulates directly with the trunk.

Most of the cases reported under the title of absence of the femur show femoral defects, and not a complete absence of the epiphyses, head, neck and shaft. Ollerenshaw[1] states that defects of the femur are usually associated with a normal or nearly normal lower segment, while Potel[2] writes that the part which most often persists is the inferior extremity of the femur, which seldom articulates with the tibia. Reiner[3] classified the femoral defects into five types, as follows:

(1) The femur is shortened and shows a delayed development with coxa vara.

(2) The femur consists of an upper and a lower end, and the middle section is absent; one or more bony nodules may be present in the region of the absent shaft.

(3) The lower end of the femur is alone present and is united with the tibia; one or more bony nodules may be present in the region of the absent upper shaft and head.

(4) The upper end of the femur is not differentiated as to head and neck, and is curved and sometimes luxated.

(5) The hip and knee joints are well developed, but the shaft is greatly shortened.

The 22 cases reviewed by the author in the recent literature can all be placed in one of Reiner's five classifications.

Potel further states that the femur in these cases may be represented, either by a fibrous band going from the ilium to the tibia, which serves as a point of insertion for the muscles, or by one or more bony cartilaginous nodules, isolated or free. He describes a rudimentary pseudarthrosis in some cases with a simple articular sac, which is found at the upper end of the imperfect femur. A case has been reported in which the tibia has assumed a branching form with two articulations with the pelvis. This was fixed to the pelvis with a strong ligamentary cord, and there was pseudarthrosis reënforced by ligaments.

Thorndike[4] in a discussion on the absence of the patella mentions 2 cases, in which there was an associated femoral defect. One of these was reported by Friedleben[5] and was in a baby of thirteen months. An autopsy was performed, showing a bilateral absence of the femur, patella, and fibula. There was found a short dense fibrous band going from the region where the acetabulum should have been to the knee, into which the thigh muscles were inserted. This fibrous band broadened out into a cartilaginous lower femoral epiphysis, in which there was an ossification center, and which was firmly fused to the upper epiphysis of the tibia. There were no ligaments present. This case falls in the third type described by Reiner. Thorndike reports a case of a baby of seven months, in whom the left leg showed an absence of the femur, patella, fibula, and outer arch of the foot. It was questionable in this case as to whether there was not a small amount of femur remaining.

Dachtler[6] reports a case of a baby aged six months, in whom the only remaining part of the femur is a lower epiphyseal mass, which forms a part of the knee joint. Harrison[7] reports a uniovular twin with a partial absence of the femur, the remaining portion being about one-fifth the length of the normal femur.

Blencke[8] reviewed 66 cases of congenital femoral defects, including 3 cases of his own. Pürckhauer[9] states that there are 80 cases of absence of the femur in the literature and reports 2 additional cases.

Slovitch[10] in analyzing the 66 cases of Blencke found 60 per cent in males, and that 58 per cent of the cases had bilateral anomalies.

Congenital absence of the patella is more common than absence of the femur. Thorndike[4] reported 51 cases of congenital absence of the patella, while Potel[2] has collected 100 cases from the literature. The association of absence of the patella with absence of the femur is found by Slovitch[10] to be in 69 per cent of the cases reviewed by Blencke.[3] Whitman[13] says that the absence or partial absence of the patella is a frequent complication of a congenital defect of the knee or limb, which involves an imperfect development of the quadriceps extensor muscle.

There can be found no reference in the literature to a congenital absence of the scaphoid; however, Anderson[11] describes an anatomical dissection of an astragalo-scaphoid bone in a man. This was a bilateral condition. The anterior articular surface of this bone is described as being very large. He further states that in crocodilia, the astragalus and scaphoid are coalesced to form one bone.

Associated congenital deformities of the pelvis with those of the femur are apparently very rare. Three of the 22 cases reviewed presented some pelvic abnormality. In Harrison's case[7] the right ischium is imperfect in shape, and the right ilium is smaller than the left. In Friedlebens' case[5] there was no acetabulum on either side, but there was a cartilaginous union of the ilium, ischium, and pubis. In the case of Perlman and Cohen[12] there was an abnormal development of the pelvis with a shallow acetabulum on the side of the femoral defect. Slovitch[10] in reviewing the 66 cases makes no mention of a pelvic deformity associated with congenital femoral defects.

The etiology of congenital deformities in the early centuries was thought to be due to the influence of devils, witches, and gods. In the early part of the nineteenth century, Meckel proposed an embryological basis for the explanation. Shortly afterwards, Geoffroy Saint-Hilaire performed the first experiments in teratology. Reiner[3] states that the causes are first, external pressure on the embryo from amniotic bands, and second a faulty development of the embryonic tissue and cartilage. Ollerenshaw[1] writes that the predominant cause is undoubtedly a cessation of growth in one or the other set of embryonic cells at a period between the fourth and sixth weeks of fetal life.

SUMMARY

A case report of a man aged twenty-three is given presenting the following congenital abnormalities:

1. Complete absence of the right thigh.
2. Absence of the shaft of the right femur with a small caput epiphysis remaining and a fusion of the lower femoral epiphysis with the tibia.
3. Pelvis. (*a*) Complete absence of the right ischium.

(*b*) Absence of the inferior ramus of the right pubis.

(*c*) An imperfect and small right ilium.

(*d*) An imperfect and small right side of the sacrum.

(*e*) An articulation between the right pubis and sacrum.

4. Complete absence of the right patella.
5. Complete absence of the right tarsal scaphoid.
6. Bony defects in the parietal bones of the skull with an oxycephalic shape.
7. Non-descent of the testes.

A partial review of the literature on the congenital bony anomalies involved is given.

Appreciation is expressed to Dr. Ford of Baltimore for the neurological examination, to Drs. Young and McKay of Baltimore for the urological examination, and to Dr. Pierson of Baltimore and Drs. Merritt, Coe and McPeak of Washington for aid in the interpretation of the roentgenograms.

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TOXIC GOITER: ITS DIAGNOSIS AND TREATMENT*

WITH SPECIAL REFERENCE TO THE ROENTGEN AND RADIUM TREATMENT

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INTRODUCTION

TODAY for the symptom-complex known as toxic goiter, hyperthyroidism, exophthalmic goiter, Graves' disease, Basedow's disease, etc., there is probably no treatment followed by better results than that of correctly applied roentgen or radium rays. Pfahler[1] with an experience dating back fifteen years including the treatment of 400 cases of the disease under discussion states that the results are at least equal to those obtained by surgery. Holmes and Means[2] state that about two-thirds of the patients with exophthalmic goiter so treated show either recovery or improvement with the treatment. The remaining third neither improve nor grow worse. Barclay[3] in a series of 300 treated cases reports as cured 63.3 per cent and 24.6 per cent improved giving a total of 87.9 per cent relieved. Jenkinson[4] says: "About 80 per cent of exophthalmic goiters will respond to X-ray therapy and in the failures, which number about 20 per cent, it is our experience that very little benefit is received, regardless of what type of therapy is used. If radiation fails to produce a cure,—speaking now of the exophthalmic type,—surgery in most cases is also a failure." Loucks,[5] with an experience in the treatment of 480 cases in eight years says: "With us, we conclude that we have what you might call a complete control of all toxic symptoms in over 98 per cent of cases." The variation noted in the statements of these men is no doubt due to the fact that radiation therapy is not yet standardized, and also to the fact that toxic goiter and hyperthyroidism cases from various localities of our country present varying types of the disease.

From the Mayo Clinic, Judd[6] reported in 1920 that 64.4 per cent of the patients operated upon were cured and that another 13.3 per cent were very much improved, 5.6 per cent slightly improved, and 16.6 per cent dead from all causes. Crotti[7] since 1912 reported approximately 60 per cent cured and 25 per cent showing marked improvement; 10 per cent showed no improvement and there were slightly more than 4.5 per cent of operative deaths. These figures represent probably the best surgical results obtained and no doubt do not show the results obtained throughout the country by less skillful surgeons or surgeons operating under great difficulties.

At the 1925 meeting of the Radiological Society of North America I[8] reported upon 100 consecutive cases, 75 per cent of which were markedly relieved or cured. Twenty-one of these cases were lost from

* Read at the Twenty-eighth Annual Meeting, American Roentgen Ray Society, Montreal, Canada, Sept. 20–23, 1927.

the records and therefore had to be recorded as cases in which the treatment failed to produce the desired result; they were unmanageable, some took one or two series of treatments and disappeared, that is, those who gave the treatment an unfair trial. There were 3 operated cases and one death.

The remarkable improvement in the quality and mentality of the cases treated in recent years resulted in almost perfect co-operation which in turn has resulted in quite remarkable results. Two male patients have disappeared and cannot be followed and there is one more death. In this series 90 per cent of the cases have been markedly relieved or cured. No case is included that has been under observation for less than one year from date of last treatment.

PATHOLOGY

Toxic goiter is due to an increase in numbers of normally secreting cells (hyperplasia) of the thyroid gland. In cases characterized by hyperplasia there is a tumor at the site of the thyroid gland. The tumor may be visible upon direct inspection or it may grow downward into the mediastinum, where it can be demonstrated by means of a roentgen study of the mediastinum. Therefore, in my clinic a tumor or enlargement of the thyroid with thyroid intoxication is called toxic goiter. Hyperthyroidism is the disease caused by thyroid cells which are normal in numbers but which are hyperactive. In such a case no tumor is visible or demonstrable. In some cases there is only a hard nodule in one lobe of the thyroid or the isthmus, and in the presence of thyroid intoxication, it is called toxic adenoma.

ETIOLOGY

Toxic goiter and hyperthyroidism are more common in women than in men. Of 200 cases, Eshner reports 161 women and 39 men, and although it is present at both extremes of life, it is more frequent during adult life. There appears to be a hereditary influence (noted in 2 of my own cases), and several of a family may suffer from the disease. Occasionally there is a history of injury just prior to the onset of symptoms. Emotional disturbance, worry, severe acute disease, and great mental or physical strain are common exciting causes of toxic goiter and hyperthyroidism. The disease may occur secondary to simple goiter.

SYMPTOMS

The onset of the characteristic symptoms is generally slow but occasionally is sudden.

In acute toxic goiter and hyperthyroidism the symptoms are excessively rapid action of the heart, vomiting, diarrhea, and marked exophthalmos, sometimes with cerebral symptoms. In cases where there is a rapid loss in weight, the condition of the thyroid should be carefully determined.

In chronic toxic goiter and hyperthyroidism increased heart action or tachycardia is almost the first symptom to appear and, not infrequently, it is present for a considerable period of time before the other characteristic symptoms of the disease appear. In cases of toxic goiter there is a tumor at the site of the thyroid which gradually increases in size, and exophthalmos, and always at some time during the course of the disease there is tremor. Upon unusual excitement or exertion the heart action increases, the action becoming violent and irregular. Palpitation and dyspnea are disturbing symptoms. In a case treated in 1924 the only symptoms of the disease present were tachycardia and diarrhea. The basal metabolic rate was moderately increased, therefore the diagnosis of hyperthyroidism was in order. Under radiation therapy only, the patient was perfectly relieved of both symptoms, and the metabolic rate returned to normal.

Physical examination of a patient suffering with toxic goiter or hyperthyroidism shows an individual who appears to be in a state of tension; often the rapidly beating heart can be seen pounding away within the chest, the pulsating arteries and, occasionally, the pulsating veins can be clearly seen. Exophthalmos is frequently present. On closing the eyes a rim of white is visible above and below the cornea; this and Graefe's sign, immobility of the

upper lid when the eye is turned downward, are two signs of great diagnostic importance. Thyroid enlargement may either accompany or follow the exophthalmos, and is due to the great dilatation of the vessels, particularly the arteries. The enlargement of the gland may be general or may be localized to one portion. The gland may pulsate; palpation may reveal a thrill, and often there is tenderness which, to me, means an associated thyroiditis. Muscular tremor, neurasthenia, and various mental disturbances are common. The temperature may at intervals be elevated, and may be associated with profuse sweating. Pigmentation of the skin is sometimes present, one case of toxic goiter being diagnosed as Addison's disease. Scleroderma, urticaria, pruritus and localized edema may be present.

The general symptoms are weakness, anemia, emaciation, etc. Leucopenia, the neutrophiles being much reduced and the lymphocytes twice the normal number, is the rule. In some cases there are hemorrhages from the nose, stomach, lungs, etc., but more commonly there are albuminuria and glycosuria. Very rarely myxedema is associated. Vomiting and purging may be present.

The diagnosis of toxic goiter or hyperthyroidism is in order when any or all of the above symptoms and signs are present, together with a positive basal metabolic rate. Basal metabolism tests frequently point the way to correct diagnoses in obscure cases, but also show in figures the value of the various methods of treatment from the standpoint of results obtained. Once the diagnosis is established and the basal metabolic rate determined, a check on the progress of cases can be kept by frequent tests; these will show whether or not treatment is efficiently meeting the indications. When the symptoms and signs of the disease have disappeared and the metabolic rate is normal, treatment ceases and a period of observation of not less than one year from date of last treatment is instituted, repeated metabolic estimations being made during this time. Basal metabolic studies are of great importance to the radiotherapist for they clearly show that no method of treatment can exceed his; in fact, in many cases there is no equal.

FOCI OF INFECTION

Any focus of infection found should, of course, be removed by the indicated method if possible. These infections are found at the roots of dead teeth, the tonsils, and colon frequently; however, a chronic appendix, gall-bladder, and genito-urinary infection must not escape attention if present.

A prominent gynecologist in private conversation once stated that our results might be due to the fact that severe chronic infection had been removed and that recovery might have followed without any radiation treatment. This is doubtful because the majority of patients treated for toxic goiter have had no evidence of any infection. Then, too, a small series of patients had only chronic infections eradicated without any definite improvement in thyroid symptoms being noted. Improvement began in each soon after active treatment was instituted. Then there have been fastidious patients who would refuse to have an abscessed front tooth extracted, for instance, and in some of these no great difficulty was experienced in obtaining the result. On the other hand, patients have failed to improve under treatment satisfactorily until some focus of infection was found and eradicated. From this discussion it is difficult to state exactly the part played by chronic infection in cases of toxic goiter and hyperthyroidism.

INDICATIONS FOR RADIATION THERAPY

Those of us who have had considerable experience in the management of hyperthyroidism and toxic goiter appreciate the fact that the diagnosis of this malady indicates at least a trial with radiation therapy; with one or both of the physical agents, roentgen rays and radium. If the operator be competent, only very rarely will anything else be necessary other than the indicated medical treatment. Associated medical measures, particularly in severe cases of toxicity, are very important, no matter what form of specific treatment is prescribed. Radiation therapy is the only method of radical treatment that can

be safely carried out in cases showing great intoxication with a high metabolic rate or in those with a low metabolic rate which is rapidly rising.

CONTRAINDICATIONS TO RADIATION THERAPY

A large tumor which is showing *distinct signs of pressure* is indication for surgical removal. This will promptly relieve the pressure symptoms and, if too little of the gland is removed to produce normality from the symptomatic and basal metabolic rate standpoints, radiation therapy can be expected to perfect conditions if used postoperatively. On the other hand, in such a case, if there is evidence of great toxicity, radiation therapy used preoperatively will reduce the operative mortality.

Someone has stated that radiation therapy is followed by dense adhesions which increase the difficulty of surgical removal should this prove necessary. In reply to a letter regarding this question, Dr. Crile[9] says: "Regarding your inquiry concerning the irradiation of thyroid cases, I have frequently operated upon patients who have had long continued treatment and have noted that these patients, if the treatment has been long enough, may have adhesions which are somewhat difficult to dissect. The ordinary case, however, which has had X-ray treatment, shows very little change as compared with other glands. As you say it might also be due to thyroiditis. A great many of these cases also have hyperplastic glands, and these cases, even without any treatment, have been very difficult to dissect out." Dr. Rogers[10] of New York City received a like questionnaire and replied: "I often have these cases X-rayed before and after operation and have never found the operative difficulties increased." To me, the statements of these two authorities are so clear and to the point regarding this question that further discussion is unnecessary.

Another objection to the irradiation of these cases is the danger of producing the opposite condition—hypothyroidism. Of course, we know that there is little or no danger of such an accident. No normal thyroid tissue can be destroyed by any such dosage as is employed in the treatment of this malady. If these patients are seen frequently and a careful examination made before each treatment together with repeated metabolic estimations, the danger of producing hypothyroidism can be forgotten.

Therefore, it appears that those patients who present severe pressure symptoms with large tumors, those who need quick relief from pressure, are the cases for surgery. Later, if toxicity still exists, radiation therapy can be added to perfect conditions. Also, those who fail to get relief after properly applied radiation therapy should be referred for surgical treatment.

TECHNIQUE FOR RADIUM TREATMENT

Radium is used in those patients who are unable to leave their beds because of the severe toxicity. It consists of using 10 mg. tubes or needles in sufficient numbers to cover the tumor. They are applied in the form of a pack filtered by the needle wall plus 1 mm. of brass at a distance of 2 cm. The distance between tubes is 1 cm. The time duration is up to sixteen hours, based on the interpretation of the individual indications. As soon as improvement warrants it, the patient is brought to the clinic and treated with roentgen rays, because such treatment can be executed more quickly.

TECHNIQUE FOR ROENTGEN TREATMENT

It is, of course, impossible for anyone to outline a technique of roentgen therapy that can be blindly followed by everyone who happens to own apparatus for the production of roentgen rays. To properly treat such a case demands not only knowledge of the disease in question, but also good judgment and detailed knowledge of the physics of radiation therapy, which, of course, come only through a thorough grounding in the subject, and much practice. However, in general, this is the plan for roentgen treatment: A vertical line is drawn through the center of the isthmus of the thyroid and extended downward through the center of the sternum to the lower border of the thymic region. Then a horizontal line is drawn at the upper border of the thyroid, extending

outward to the distal edges of the gland. Here two more vertical lines are drawn, one at the right and one at the left. The rays are then applied in such a way that the central beam passes through the center of each lobe of the thyroid, and downward and inward into the thymic region. Then the patient is put in the prone position and the rays are applied through two posterior ports, exactly as was done with the patient in the supine position. The factors are 4 ma., 140,000 volts, 30 cm. distance, and the equivalent of 6 mm. Al filter. In very toxic cases this treatment, if applied in proper dosage, can be repeated in two weeks, otherwise an interval of four weeks is generally allowed. Thereafter, treatments are repeated, allowing increasing intervals of time between treatments, or as indicated by the clinical condition of the patient and basal metabolic rate estimations.

CLINICAL COURSE FOLLOWING IRRADIATION

1. Occasionally cases of toxic goiter and hyperthyroidism suffer with increased toxicity for a few days following the initial treatments. Fortunately this is soon followed by relief and gradual improvement takes place.

2. Nausea, vomiting, and diarrhea when present are among the first symptoms to improve or disappear.

3. Early during the course of active treatment the strength begins to improve and pruritus disappears. Soon the weight increases, palpitation, tachycardia, tremor, dyspnea, and the size of the tumor decrease and finally disappear. At this time the basal metabolic rate will generally be found to be within normal limits.

4. The eye symptoms are among the last to disappear and in some cases the exophthalmos never completely disappears.

5. Cases that have had severe thyroid intoxication for months or years frequently develop myocarditis. In these cases the pulse rate is lowered but may never return to a perfect normal no matter what the method of treatment; whether radiological or surgical.

6. If toxic goiter is superimposed upon simple goiter, cystic goiter, etc., the original tumor remains after treatment; the enlargement of the gland appearing at the time of the development of toxicity disappears. In hyperthyroidism, i.e., thyroid intoxication without enlargement of the thyroid gland superimposed upon simple goiter, cystic goiter, etc., treatment is followed by no reduction in the size of the primary tumor.

CASE REPORTS

CASE I. Mrs. R. B.; housewife, aged forty-two; weight 113¼ lb.: referred by Dr. C. D. Cropsey, Feb. 18, 1926. She has complained of nervousness for five and one-half years, loss of weight, enlargement of the thyroid, exophthalmos, tremor, insomnia, and a discharging left ear. Lately slight excitement, trolley-car riding, for instance, causes nausea and vomiting. Pulse was of bounding type, irregular, and 138 frequency per minute. The basal metabolic rate was +80 per cent.

From Feb. 18, 1926, to Aug. 26, 1926, nine series of roentgen treatments were given. Then she was seen frequently until Dec. 21, 1926, when she was discharged from active treatment and a period of inspection and repeated metabolic estimations was instituted.

Result. Weight 132 pounds; pulse soft, and regular, 70 per minute; she is not nervous, there is no tremor; the exophthalmos and enlargement of the thyroid have disappeared; she sleeps well and does not suffer with nausea and vomiting upon slight excitement. The day of discharge, Dec. 21, 1926, the first metabolic rate of zero was obtained; on Aug. 3, 1927, a reading of −2 per cent was obtained, and the last was taken June 8, 1927 and was found to be −1 per cent. After active treatment was completed several dead abscessed teeth were extracted and at the present time there are no complaints.

CASE II. Mrs. A. S.; housewife, aged twenty-nine; weight 121¾ lb.; referred by Drs. J. V. Bergin, Norman M. Dingman, and Harry N. Golding, Dec. 6, 1926. The difficulty began about one year ago with marked exophthalmos, extreme nervousness, tremor, palpitation, loss of weight, shortness of breath, insomnia, irregular menstruation, and rapid enlargement of the thyroid gland. Tremor was easily seen and felt, the pulse was 144 per minute, and the blood pressure was 140 65.

From Dec. 6, 1926, to Feb. 10, 1927, four series of roentgen treatments were given. On July 20, 1927, the metabolic rate is −10 per cent; Sept. 10, 1927, metabolic rate zero.

Result. Weight 129 lb., pulse 64, and the only remaining symptom of toxic goiter is exophthalmos which, however, is considerably

less than at the time of the first series of treatments.*

CASE III. Miss R. V.; stenographer, aged twenty, weight 138 lb.; referred by Dr. Henry G. Holler, April 20, 1926. The difficulty began in February, 1925, with a swelling in the region of the thyroid gland and a sensitive throat. Great nervousness, palpitation, loss of weight, and exophthalmos soon appeared. Patient has never had a sore throat and there are no dead teeth. The pulse rate was 150 and of the bounding type. Blood pressure 128/65. Exophthalmos was marked and the tumor of the thyroid was as large as an orange. No metabolic estimation could be made.

From Apr. 24, 1926, to Sept. 28, 1926, seven series of roentgen treatments were given. Then she was seen frequently until Nov. 11, 1926, when she was discharged from active treatment and a period of inspection and repeated metabolic estimations was instituted.

Result. Weight 145¾ lb.; pulse 70 and of normal tension; the thyroid gland has returned to normal size; she is not nervous; there are no complaints of palpitation, but there is a slight residual exophthalmos. Nov. 10, 1926, the metabolic rate was found to be zero, and Jan. 19, 1927, it was −1 per cent. Patient was seen Sept. 1, 1927, when she brought her husband's mother who had already been operated upon once for toxic goiter and who now appears to be suffering with a recurrence. At this time the reported case appears perfectly well and there are no complaints.

Oct. 5, 1927 thirteen months after treatment was completed, weight 140, pulse 72, metabolic rate +2 per cent.

CASE IV. Mrs. C. H. V.; housewife, aged forty-five, weight 129 lb.; referred by Dr. William H. Cooke, Dec. 21, 1926. The trouble began in the fall of 1926 with tiredness, palpitation, tremor, loss of weight, nervousness, exophthalmos, and slight enlargement of the thyroid gland. Examination showed the pulse to be of bounding type and of 138 frequency per minute. The blood pressure was 165/80. Tremor was easily seen and felt. Basal metabolic rate was +53 per cent.

From Dec. 30, 1926, to June 25, 1927, eight series of roentgen treatments were given. The symptoms and signs began to disappear shortly after the fourth series of roentgen treatments which was given March 8, 1927, and the metabolic rate gradually reduced. Aug. 20, 1927, the metabolic rate was zero.

Result. Weight 144 lb., pulse 72 and of normal tension; the enlargement of the thyroid has disappeared, and there are no complaints of any of the above symptoms of the disease.

CASE V. Mrs. M. W.; housewife, weight 130 lb.; a patient of Dr. John F. Hagerty; came for treatment April 1, 1926. The difficulty began suddenly in June of 1925 following a shock when a tumor began to appear in the thyroid gland. Slowly this continued until the entire gland was involved. Patient also complained of nervousness, exophthalmos, tremor, shortness of breath, palpitation, weakness, nausea, vomiting, diarrhea and loss of weight. Examination showed the pulse to be most irregular, 120 frequency per minute, and the tremor was easily seen and felt.

From April 5, 1926, to Sept. 3, 1926, seven series of roentgen treatments were given and on July 8, 1926, she was discharged, with a metabolic rate of zero. Nov. 2, 1927, fourteen months after treatment was completed, weight 160½, pulse 70, metabolic rate zero.

Result. Weight 155 lb., pulse regular and of 72 frequency per minute, and every symptom has disappeared except some residual exophthalmos which is much less than at the time of the first series of treatments.

CASE VI. Miss B. W.; Salvation Army worker, aged twenty-five, weight 80¼ lb.; referred by Dr. W. E. Doremus, Dec. 20, 1924. The trouble was first noticed one and one-half years ago when patient complained of nausea without vomiting, weakness, nervousness, palpitation, tremor, and slight enlargement of the thyroid gland. In November, 1927, Dr. Doremus ligated the thyroid arteries which was followed by marked improvement. Thyroidectomy was attempted but when patient collapsed during first stages of the anesthetic operation was given up. Puberty at fourteen years of age; then three years with no periods at all, and then most irregular menstruation. Dr. Doremus found the metabolic rate to be +85 per cent.

From Dec. 20, 1924, to Feb. 13, 1925, three series of roentgen treatments were given. This was followed by a return to normal, and Dr. Doremus found the metabolic rate to be zero. Nov. 28, 1925, it was found that symptoms were beginning to reappear and four further series of roentgen treatments were added, the last being given Jan. 1, 1926. Then a period of repeated inspections and basal metabolic estimations was instituted, resulting in the final discharge of the patient March 19, 1927, when there were no symptoms of toxic goiter and the basal metabolic rate was zero.

Result. Weight 106 lb., pulse 70; nausea, weakness, nervousness, palpitation, tremor, enlargement of thyroid absent and the periods are regular.

* Fourteen months after treatment (Apr. 4, 1928) weight 132, pulse 60, basal metabolic rate −2 per cent.

March 19, 1927, fourteen months after treatment was completed the metabolic rate is still zero, pulse 70, weight 106.

Case VII. Mr. H. M. C.; pilot, weight 167 lb.; referred by Drs. C. D. Cropsey and W. E. Doremus April 21, 1924. The difficulty began about eight months ago with a loss of 41 lb.; ashen color, weakness, tiredness, nervousness, palpitation, and for the past three months a gradual enlargement of the thyroid gland. Patient was carried into the clinic; pulse 114 per minute. Dr. Wright MacMillan reported the basal metabolic rate to be +82 per cent.

From Apr. 21, 1924, to Dec. 9, 1924, eight series of roentgen treatments were given. Every symptom disappeared, patient went back to his work, and Feb. 17, 1925, Dr. MacMillan reported the metabolic rate to be still −2 per cent.

Result. Weight 187 lb.; pulse 60 per minute; perfectly well, and during summer of 1925 New York Life Insurance Company granted further insurance.

SUMMARY

1. The terminology together with results obtained by radiotherapeutic and surgical authorities are reviewed briefly.

2. Correctly applied radiation therapy is second to no other method of treatment, and may be expected to cure about 90 per cent of the cases.

3. The pathology, etiology, symptoms, physical findings, metabolic estimations, and diagnosis are stated.

4. The part played by foci of infection is discussed.

5. The indications and contraindications are reviewed at some length.

6. The technique for both radium and roentgen treatments is stated and the clinical course following this method of treatment is outlined.

7. Seven cases are recorded for illustration of results obtained.

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THE TREATMENT OF HYPERTHYROIDISM*

A CONSIDERATION OF THE METHODS NOW IN USE

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THE present-day treatment of hyperthyroidism does not attain ideal objectives. Our knowledge of the pathogenesis of hyperfunction or malfunction of the thyroid gland does not include an understanding of the ultimate factor or factors responsible. It follows, therefore, as Foster,[1] and Read[2] have emphasized, that our treatment of the condition must remain to a degree empirical. Whether we are dealing with the so-called toxic adenomatous or the diffusely hyperplastic toxic (exophthalmic) gland, our therapy, at most, probably but breaks a link in the vicious chain, and only too often we see our patients with disappointing residual symptoms or recurrence of toxic manifestations. The multiplicity of methods of treatment used in the past, and the differences of opinion now existent between surgeons, radiologists and clinicians, reflect the fact that we are still groping in the dusk of uncertainty.

Several factors combine to render difficult the evaluation of any given type of treatment. Among these are: (1) our lack of exact knowledge of the actual cause of hyperthyroidism, and its relation to the sympathetic nervous system and the other endocrine glands; (2) the notorious variability of its spontaneous course, with its tendency to acute exacerbations, spontaneous remissions, and even permanent cessation; (3) the confusing temporary effect of rest, hyperalimentation and sedative medication, which are often component parts of other methods of treatment; (4) the effects of iodine therapy, which are not yet completely understood, and (5) the difficulty of following patients over a sufficient period of time to determine the permanence of alleged "cures," and the paucity of reliable statistics on this phase of treatment. A method of treatment to approach the ideal should fulfill the following requirements:

1. It should entail a minimum amount of immediate risk.
2. It should produce a maximum percentage of patients economically and socially restored, with a minimum of residual symptoms.
3. It should involve the least possible loss of time and earning power during its application.
4. It should be followed by a minimal number of recurrences.
5. Its effects should be apparent in the shortest possible time.
6. It should be effective in checking permanently the complications of hyperthyroidism, particularly heart disease.
7. It should be available to the average majority as well as to the expert few.

Let us consider the merits of the types of treatment now in use. Three principal modes of therapy are in favor at present, either used separately, in combination or succession. These are: (1) The so-called medical treatment; this includes prolonged rest, psychic support and sedative medication, hyperalimentation, the removal of focal infection, at times the temporary use of iodine (as during an acute exacerbation or crisis) and in some instances insulin. Attention has been called to its advantages in recent years by Hyman, Kessel and Lieb,[3] Read,[2] and Eason.[4] (2) Radiation, which includes the use of the roentgen ray or radium with or without a regimen of rest, elimination of focal infection, and intermittent iodization. (3) Surgery, which comprises a variety of procedures: ligation of the thyroid vessels, lobectomy, partial lobectomy, subtotal and maximal subtotal thyroidectomy, and even total thyroidectomy in certain instances. Surgical treatment is now practically always associated with some preliminary rest and iodization, and often with removal of focal infection.

(1) *Medical Treatment.* This in reality

* From the Thyroid Clinic, Hospital of the University of Pennsylvania; read at the Twenty-eighth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Montreal, Canada, Sept. 20–23, 1927.

consists largely in "skillful neglect," and it is used much less extensively than radiation or surgery. The disease is allowed to run its spontaneous course under optimal circumstances, i.e., with the patient at mental and physical rest, well nourished, with focal infection removed, and protected by iodine and other agents against crises. Quinine hydrobromide is sometimes employed as an adjunct. This general type of treatment received favorable mention at the meeting of the Royal Society of Medicine in June, 1926. Hyman and Kessel[5] report 83 per cent of a series of 50 patients economically restored after twenty-five months, with only 4 per cent of recurrences, although the occurrence of some residual symptoms referable to autonomic imbalance was admittedly high; and Read reported a mortality of 4 per cent in an "untreated" series. Eason favors medical treatment in most cases, but does not offer statistics.

The principal advantages of this type of therapy appear to lie in the fact that the dangers attendant upon and following operation are eliminated and that a reasonably satisfactory percentage of improvement or recovery is obtained, with a mortality approximating that of surgery as done by the average general surgeon. The mortality is probably higher than that now recorded in the larger surgical clinics where special attention is paid to thyroid surgery.

Serious disadvantages seem to be: (1) The prolonged duration of treatment; this is seldom less than three or four months, and often as long as two years. It is frequently difficult to persuade patients to carry out such a prolonged course, both for economic reasons and because they are familiar with the prompter results of operation. (2) The confessed ineffectiveness of such treatment in checking visceral damage, particularly cardiac disease. Even the most ardent advocates of medical therapy advise operation in cases of adenomatous goiter with cardiac involvement. Less frequent complications (nephritis, hepatic degeneration) are likewise more effectively combatted by removal of the thyroid. (3) The questionable wisdom of subjecting patients to the vagaries of the spontaneous course of their disease, in view of the reported modern efficacy of specific therapy (expert surgery or radiation). In general, medical treatment as a method in itself does not appear desirable in most cases, although the extreme importance of medical supervision in connection with specific therapy must not be forgotten.

(2) *Radiation.* It is unnecessary to note here the popularity of this type of treatment. However, despite the extensive literature on the subject, it is difficult to find more than a few careful statistical analyses of the final results of irradiation. Most writers have not followed their patients for a sufficient period, and are indefinite in their interpretation of "cures" and improved patients. Loucks[6] has reported marked success with radium, even noting disappearance of arrhythmias. Larkin[7] obtained "improvement" in 80 per cent of 20 cases (all types) and cures in 30 per cent. Butler[8] reported 27 cures in 35 exophthalmic cases. Quigley[9] reported cures in 12 and improvement in 2 of 23 exophthalmic cases, and Burrows and Morison[10] obtained "perfect" results in 20, good functional results in 20, and improvement in 40 out of 100 cases. Sanger[11] has reported 82 per cent of recoveries in 50 patients treated by roentgen rays, some of whom were followed as long as five years. The apparent advantages of irradiation are: (1) elimination of immediate risk; (2) the comparative ease with which the procedure is carried out, and (3) minimal interference with the patient's ordinary mode of life. The principal objections appear to be: (1) the absence of conclusive statistics as to the percentage of recoveries; (2) ineffectiveness in arresting cardiac and other visceral complications; (3) the probably greater likelihood of recurrence as compared to surgical treatment, and (4) prolonged duration of treatment and lapse of time before results are apparent. The careful studies of Means, Holmes[12] and their associates on this subject merit consideration. They concluded that roentgen-ray treatment is not ideal, although worthy of trial in most cases; operation was recommended in those who do not respond satisfactorily

after three or four months. They consider iodization followed by subtotal thyroidectomy the most desirable program in general. Muir[13] apparently regards radium treatment as a "hit-or-miss affair."

(3) *Surgery*. This is the most popular single method of treatment at present, because of the increasingly satisfactory reports as to operative mortality and end-results. For example, in 1920 Judd[11] reported 79.4 per cent of 100 cases of exophthalmic goiter either cured or markedly improved six years after operation, and 88 per cent of 100 toxic adenomatous cases in the same condition two to three years after operation. Pemberton,[15] in 1923, reported 79.5 per cent of 311 exophthalmic cases cured or sufficiently improved to carry on their work five and a half years after operation; only 3 per cent were unimproved. Elliott[16] recently reported all of 100 patients with hyperthyroidism of all types carrying on their work six months to six years after maximal subtotal thyroidectomy—70 per cent were perfectly well; 30 per cent were conscious of some disability; 4 per cent have persisting symptoms sufficient to require re-operation. The majority of the recovered group were well within six months. Not many years ago surgical mortality varied between 4 and 8 per cent; in 1926 the Mayo Clinic mortality for hyperthyroidism was slightly over 1 per cent; and that at the Lahey Clinic in Boston 0.52 per cent.

Among the principal advantages of surgical treatment are: (1) High percentage of economic restitution; (2) greater effectiveness in arresting cardiac disease; (3) prompter appearance of improvement, and (4) fewer recurrences of symptoms. Unquestionable disadvantages are: (1) the immediate mortality, low though it be, remains greater than with irradiation, and (2) the occurrence of postoperative accidents and complications.

The Thyroid Clinic at the hospital of the University of Pennsylvania is directed by representatives of the radiological, medical and surgical departments, and includes an out-patient and follow-up department. We have been particularly interested in observing the effects of radium therapy in selected cases of hyperthyroidism (chiefly of the hyperplastic toxic type) during the past two years. Patients selected were either those without complications in whom two or three months' delay of operation did not seem likely to prove harmful, or advanced cases which were considered poor operative risks. In all, 38 cases have been followed satisfactorily enough to permit some conclusions to be drawn concerning them. The method of treatment consisted of cross-fire irradiation of both lobes and the isthmus, and was also directed below the clavicles on either side of the midline in order that any substernal extension might be included. An additional reason for exposing this area is because not infrequently a persistent thymus is associated with hyperthyroidism and should be treated at the same time. The technique employed was the radium pack 3 cm. square; distance 0.5 cm., filter 1.5 mm. brass plus 1 mm. of rubber; 300 mg-hr. of radium was employed; the time was 20 minutes. This is slightly over two-thirds of an erythema dose. We planned to use a relatively small dose at first on account of susceptibility of the skin of the neck to irradiation, especially in hyperthyroidism. Two portals were irradiated daily, the total number depending on the size of the thyroid. The largest number has not exceeded 13 portals.

Numerous factors demand consideration in attempting to classify degrees of improvement or retrogression, and the task is often made more difficult by lack of correspondence in symptom changes; thus a patient may have a normal metabolic rate four months after treatment, and yet have failed to gain weight; or show tachycardia on slight exertion or excitement; or still be nervous and tremulous, etc. The value of the basal metabolic test as an index of the severity of hyperthyroidism (particularly with the exophthalmic type of gland) is now generally accepted, and we have utilized variations in this factor as the chief standard by which to estimate degrees of improvement or the reverse. The general condition of the patient, his ability to carry on his usual life, etc., must of course be considered as well.

The period of observation following treatment varied from one to sixteen

months. The patients have been arbitrarily divided into five groups:

I. Those with normal metabolic rates and without hyperthyroidism, able to follow their occupations, but in some instances with minor residual symptoms (tremor, nervousness, exophthalmos, etc.).

II. Those showing moderate or marked improvement (reduction of metabolic rate) but not relieved of hyperthyroidism, although in most instances able to continue work.

III. Those showing slight improvement.

IV. Those showing no improvement.

V. Those in whom cure was not anticipated, but who were treated as a preparatory phase before operation (these were cases markedly advanced or with complications).

The 38 patients were classified as follows:

Group I—9 or 23.7 per cent.
Group II—7 or 18.4 per cent.
Group III—8 or 21.0 per cent.
Group IV—9 or 23.7 per cent.
Group V—5 or 13.1 per cent (of this group, 4 were successfully operated on).

In addition, it was found necessary to operate on eleven patients in Groups III and IV—all of these survived operation and either completely recovered or were markedly improved. There was no mortality from the use of radium alone. The various groups have been analyzed as follows:

I. Nine patients, or 23.7 per cent. The ages varied from eighteen to thirty-nine. The duration of symptoms varied from two months to six years, and the period of observation from four and a half to sixteen months.

These consisted of all hyperplastic toxic cases. The basal metabolic rate was not over +47 per cent before treatment. All but 2 of these patients received two series. The basal metabolic rate when last taken was not above +15 per cent in any case, and varied from that figure to −15 per cent. The average decrease in basal metabolic rate was 41 per cent.

II. Seven patients or 18.4 per cent. The ages varied from seventeen to forty-six. The symptoms had been present for from two months to eight years. The period of observation has varied from three to sixteen months. One patient was classified as having a toxic adenoma; the remaining 6 were hyperplastic toxic. Metabolic rate before treatment was not above 57 per cent in any case. Three of the group received only one series of exposures. The metabolic rate when last taken after treatment in this group varied from +42 to −10 per cent. In the patient with the latter reading sufficient nervous disturbance and tachycardia have persisted to prevent our placing her in the first group. The average decrease in basal metabolic rate was 17.7 per cent.

III. Eight patients or 21 per cent. The ages varied from sixteen to sixty years; the duration of symptoms from two months to eleven years, and they have been under observation since treatment for from one to eight months. One had a toxic adenoma, one a mixed type, and the remainder hyperplastic glands. Basal metabolic rate before treatment varied from +25 to +53 per cent, and after treatment from +19 to +39 per cent. All but 2 of this group received two series. The average decrease in basal metabolic rate was 11 per cent.

IV. Nine patients or 23.7 per cent. The ages varied from twenty-one to fifty years, and the duration of symptoms from two months to eight years. All were of the hyperplastic toxic type. They have been followed for from one to fifteen months since treatment. The basal metabolic rate before treatment varied from +32 to +56 per cent; after treatment from +21 to +25 per cent. Three of the group received two series. All but one were subsequently operated upon, with uniformly good results to date. The average decrease in basal metabolic rate was 0.4 per cent.

V. Five patients or 13.1 per cent. The ages varied from twenty-one to fifty-three years; the duration of symptoms from five months to two years. The time required to prepare these patients for operation varied from two to eight months. Four of the group were in an advanced stage of thyrotoxicosis; the fifth suffered from severe cardiac damage. All were considered bad surgical risks when treatment was begun, but only one mortality resulted from operation. All the patients had hyperplastic toxic glands. There was an average decrease in basal metabolic rate of 26 per cent.

In considering the facts set forth above, it should be remembered that all of these patients are still under observation; that only a short time has elapsed since the treatments of some were completed, and that future developments may force us to change the grouping. It should also be remembered that no patients with advanced thyrotoxicosis or severe complications have been treated with radium alone.

There appears to be no criterion which

will enable us to determine in advance what group of patients with mild or moderately severe intoxication will respond to radium therapy. Likewise a study of age groups, sex, and duration of symptoms sheds no light on the probable type of response. Undoubtedly, the patient's mode of life and activity plays an important rôle; unfortunately, these factors could not be uniformly controlled in our series.

In most cases there has been noted a tendency toward an immediate exacerbation of symptoms with temporary rise in metabolic rate for a period of four weeks after treatment. Improvement is usually manifest within two to three months, if it is to occur at all. When a second series of exposures has been given, it has been deferred until four to six weeks after the first series.

The end results of surgery in our clinic during 1925 and 1926 have been recently reported by Frazier and Mosser in an unpublished paper, from which, by permission, I quote. Of 101 patients with hyperplastic toxic goiter followed up at an interval of at least six months after operation, 71 per cent were classified as entirely relieved; 19 per cent as relieved of hyperthyroidism but showing certain residual symptoms (tremor, exophthalmos, etc.) despite normal metabolic rates; 6 per cent relieved of hyperthyroidism but handicapped by visceral changes, notably cardiac; 1 per cent unrelieved and 4 per cent with recurrence.

Of 45 cases of toxic adenoma so-called, 87 per cent fell in Group I, 8.7 per cent in Group II, 4.3 per cent in Group III, and 0 per cent in Groups IV and V.

Of the entire group, 96.6 per cent were considered to have been relieved of the hyperthyroidism (with complete restitution in 75 per cent); 3.4 per cent were classified as operative failures. The writers found a direct relationship between the degree of postoperative disability and the duration of the disease, indicating the importance of each treatment. The immediate operative mortality in the period covered was less than 1.5 per cent.

It is obvious that, even with allowance for the shorter observation period, radium in our experience does not compare favorably with surgery as a therapeutic agent. It also seems probable that had an unselected group of cases been treated with radium, our results would have been even less satisfactory. In many communities, however, surgery of the thyroid is done more or less casually. The low mortality and high restitution percentages quoted above are from large, well-organized clinics, where expert technique obtains, and statistics from smaller hospitals might tell a different story. This should be borne in mind when considering treatment outside of a special thyroid clinic, when the practically non-existent mortality of radiation therapy and its ease of application may swing the balance in its favor.

In conclusion it may be said:

(1) The so-called medical treatment of hyperthyroidism is inferior to surgery and radiation, and should not be used alone unless the patient declines specific treatment.

(2) Medical supervision in association with surgical or radiation therapy is of the greatest importance, particularly in relation to visceral complications.

(3) Removal of active harmful foci of infection should accompany or precede any type of treatment selected.

(4) A trial with radium or roentgen rays is indicated:

(*a*) In mild or acute cases of hyperplastic type without complication, where a three to four months' period of observation is economically possible and without risk to the patient.

(*b*) In cases of any type which are considered bad surgical risks; in these subsequent operation can often be successfully performed.

(5) Surgical treatment is indicated:

(*a*) In all frankly adenomatous goiters with hyperthyroidism.

(*b*) In all cases of hyperthyroidism with visceral complications.

(*c*) In all cases which have not responded satisfactorily to irradiation after four to six months.

(6) Until more convincing statistical proof of the ultimate efficacy of irradiation is offered, surgery must be considered, in general, the most satisfactory type of treatment for hyperthyroidism.

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THE RADIATION RISKS OF THE ROENTGENOLOGIST

AN ATTEMPT TO MEASURE THE QUANTITY OF ROENTGEN RAYS USED IN DIAGNOSIS AND TO ASSESS THE DANGERS

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IT is obvious that man can tolerate some quantity of radiation without ill effect. In this paper we attempt to arrive at a figure that will represent a safe daily limit of exposure to radiation.

To obtain exact information as to the actual quantity of radiation, either primary or secondary, produced in the diagnostic services of a roentgen-ray department is obviously impossible owing to the number of variables. Believing, however, that an approximation would be of value, we have attempted to reconstruct the old conditions and also to assess the quantities of the radiations that are nowadays produced under average working conditions and to express these quantities in terms of the only known factor that bears any relation to the human body, i.e., the unit skin dose (U.S.D.).

ASSUMPTIONS

Many assumptions have to be made which may not be scientifically accurate but which involve a margin of error that is probably negligible by comparison with other variables that complicate the problem. For instance, we are assuming that the rate of discharge of the electroscope is the same for a given quantity of radiations within the limits of the range of wave lengths that are employed in roentgenography, roentgenoscopy and light roentgen-ray therapy (minimum peak of 0.089 Angström units), an assumption that medical workers accept in therapeutic work over a wider range of voltages with no serious effects on their patients in the way of unexpected reactions, etc.

We are also assuming for the purpose of these investigations that the secondary radiations have the same characteristics as the primary beam, and that their effect on the electroscope and on the skin is the same.

BASIC STANDARD—THE UNIT SKIN DOSE

For the whole of this work we have started from the unit skin dose measured

at the half distance ($4\frac{1}{2}$ in.) without the interposition of any filter at all. For the measurement of the unit skin dose (which took eight minutes at 9 in.) a number of readings with the pastilles of Sabouraud and Noiré were made to confirm our standard technique on the light or ordinary roentgen-ray therapy apparatus (16 in. coil working at a sphere gap peak reading 0.089 A, 6–7 in. point to point). This is the accepted standard setting in the department where the readings were made, but the variations of main current are such that, in testing for these readings, we obtained peak records of as low as 0.113 A under what were supposed to be normal conditions. In actual practice, the therapeutic results are satisfactorily uniform, i.e., the unit skin dose does not vary to any very great extent, and unexplained or unexpected reaction is unknown. The measurements of the discharge of the iontoquantimeter were made, however, when the readings gave 0.089 A as peak with 1.8 to 2 ma. We took the unit skin dose produced under the above conditions as our standard.

INSTRUMENTATION

The instrument used for the measurements was an iontoquantimeter (Schall's manufacture). In order to make it more sensitive the aluminum ionization chamber was eventually replaced by a round cardboard box (size 5 in. length × $5\frac{1}{2}$ in. diameter) coated inside with aluminum paint and varnished outside with shellac. The electrode itself was increased in size by the addition of a brass rod (size $3\frac{1}{2}$ in. × $\frac{1}{4}$ in. diameter). With these modifications we found that the sensitivity of the instrument was so much increased that we could obtain a sufficiently rapid reading of the discharge due to the secondary radiations whenever these were present in fairly large quantity.* We also fitted this ionization chamber with taps, enabling us to fill it with methyl bromide for increased sensitiveness.†

* It was sufficiently delicate to indicate quantities which corresponded to what we later on deduced as our safety limit.

† For these suggestions and for facilities for carrying out the preliminary tests, we are indebted to Prof. W. L. Bragg and his department at the Manchester University. The actual measurements were made at the Manchester Royal Infirmary and in a private clinic in Manchester.

CALIBRATION OF THE INSTRUMENT

Other factors being constant, we assumed that the intensity, i.e., quantity, of the primary radiation varied inversely with the square of the distance. Using this factor for calibration purposes, we found that with our large ionization chamber our iontoquantimeter was 7·8 times more sensitive than the original instrument.

When we filled the chamber with methyl bromide, there was a further increase of sensitiveness, between 20 and 25 times, depending on the density of the gas in the chamber—a factor that necessitated calibration each time we filled the instrument with gas. With this sensitive instrument we obtained our readings of the smaller quantities of secondary radiations, and the residue of the primary beam that had found its way through several layers of lead foil.

With these degrees of sensitiveness, we obtained our readings in periods of time that made it unnecessary to make any allowance for natural leak. We had therefore succeeded in calibrating our iontoquantimeter and could read its discharge to scattered and secondary radiations in terms of the unit skin dose.

KNOWN CONDITIONS OF TOLERANCE TO ROENTGEN RAYS

Certain facts are known as to the tolerance of the human skin to roentgen rays.

(1) The skin can only tolerate a certain quantity of radiations without ill effect. This quantity is the unit skin dose.

(2) Given a period of rest (six weeks is the usual period allowed), the skin will again stand the same dose, but this tolerance diminishes if exposures are repeated.

(3) One-half U.S.D. can be given on three successive days, i.e., a total of $1\frac{1}{2}$ U.S.D., without producing any greater reaction than with a single U.S.D. given at one sitting.

(4) With doses at three or four day intervals, between $\frac{1}{3}$ and $\frac{1}{2}$ U.S.D. has been given for months without any ill effect on the skin.

Tolerance in Roentgen-ray Workers. Absence of ill effects in unprotected roentgen-ray workers of long standing gives definite

indication that large quantities of radiations can be tolerated without injury.

There is no question as to the cumulative effect of roentgen-ray doses of a certain magnitude, but it is evident that the time interval between the doses is a very potent factor. We might put it that the larger the dose, the longer the interval, while the smaller the dose, the more frequently can it be repeated without fear of cumulative effect and actual damage to the skin structures.

Workers in old roentgen-ray departments have been exposed for years to a daily dose that must in the aggregate amount to a vast quantity of radiations. For one operator, who is still in charge of roentgen-ray therapy, we have worked out the figures, reconstructing the conditions as accurately as possible for the years 1917 to 1922. Neither in this period, nor since, has she been ill, shown any indication of either direct or remote effect from the enormous quantities of radiation in which she existed during these six years. On reconstructing the conditions,* we find from electroscopic readings (which not only take in the secondary rays, but also the primary beam arising from the stems of the anticathodes which extended outside the tube boxes) that she sustained a *daily* dose of at least $^1/_{140}$ or 0.007 U.S.D. for each working day of the week.

During the war, all roentgenologists were exposed to vast quantities of radiations, not only because of the nature of the work, but also because the protective devices were so very defective. Of all this exposure it is obviously impossible to form any estimate, but we have measured up the additional exposure sustained by one roentgenologist in the private work (chiefly therapeutic) which he carried on at the same time. Practically every afternoon he sat at his desk while patients were being treated for an average of one hour within 4 to 5 ft. of a Coolidge tube (operated at a 6 in. point to point spark gap with 1.8 ma.) carried in an open wooden box with lead rubber lining of approximately 0.75 mm. lead value. Taking an average for *this exposure alone*, we find that he was subjected to a daily dose of primary and secondary radiations amounting to about $^1/_{440}$ or 0.0023 U.S.D. Added to this was all the exposure he received in military and other hospital practice. It is probable that this worker received a daily dose that was very far in excess of the 0.007 U.S.D. above recorded.

It is clear, therefore, that the time during which the subject is exposed to the rays is of as much importance as the total quantity to which the skin is exposed, i.e., an enormous quantity can be tolerated, provided it is divided into small enough doses, and the intervals are not too close together.

DEDUCTION OF A SAFETY LIMIT—0.00028 U.S.D. DAILY

We therefore have two definite figures of the quantity of radiations tolerated over long periods without known ill effect, i.e., one case of 0.007 U.S.D. daily for six years, and another of 0.0023 U.S.D. which was only a fraction of the total dose.

These quantities are exceedingly small, yet the protection of these two workers was possibly as inadequate as that of any others at this period.

Using these two observations, can we arrive at a figure as being safe, and one that can be tolerated day after day without risk? We suggest that a protection scheme that reduces the *possible* incidence of rays on the operator to a daily dose that is in the region of $^1/_{25}$ of that which has been known to be tolerated without ill effect (0.007 U.S.D.) must be well within the limits of safety. We therefore take as our arbitrary standard 0.00028 U.S.D. as our safe limit for daily exposure. Provided that confirmation of these figures can be had from other workers, we believe that a *possible* small daily exposure of this magnitude would be absolutely harmless and could be used as a basis of safety for all workers who are in any way exposed to roentgen radiations of medium wave lengths.

The question of *idiosyncrasy* will of course be raised. While admitting that there is such a thing as variation in human tolerance, we believe the limits of variation

* In this period she had charge of three 16 in. coils, housed in a basement room (size 18 × 13 × 10 ft. high) and she spent practically the whole of her time at a desk in the corner beside the one window. The only protection afforded was the lead rubber of the open wooden boxes in which the tubes were housed. Under these conditions she gave 43,456 treatments of an average length of twenty minutes each in the six years.

are comparatively narrow, amounting to only a small fraction of the total dose given.

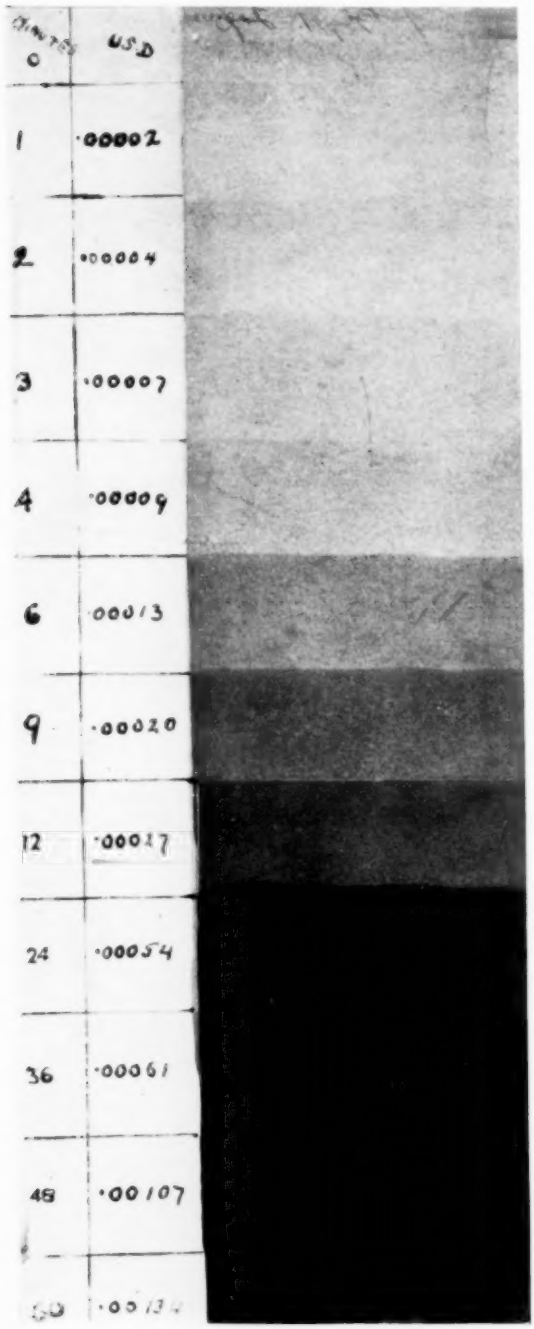

FIG. 1. Photographic measurement of small quantities of roentgen radiations.

If it were not so, the almost mathematical certainty with which the well-organized and controlled clinics deal with ringworm would not be possible. The margin that divides success from disaster in these cases is a narrow one, and disaster would be frequent and not the almost, if not quite unknown happening. MacKee[1] states that the use of the word idiosyncrasy has disappeared in direct proportion to the knowledge of technique and of those factors such as irritants which accentuate the action of rays.

Photographic Measurements of Small Quantities of Radiation. The lighting up of the roentgenoscopic screen and the effects on ordinary duplitized roentgenographic film of the quantities of radiations approximating our daily safety limit form a rough guide for the worker.* For this purpose we reproduced the conditions under which the radiologist worked (see page 553). An ordinary standard Eastman film was exposed in the position in which he sat at his desk and iontoquantimeter readings were made at the same time in the same position. The film was developed in the tank under standard conditions at 65° F. (Fig. 1). It will be noted that the quantity of radiations indicated by the heaviest blackening of the film was tolerated by this worker for years without any ill effect on the skin or cutaneous structures—this, however, does not argue that he did not, unwittingly, take grave risks.

From our measurements we conclude that the maximum blackening of a film either carried by or placed in the position of the worker for the whole of a day's work should never exceed that indicated by the shade produced in twelve minutes on our scale, since this corresponds roughly to the safety limit.

On the scale reproduced are given:

(1) The time during which the film was exposed.

(2) The quantity of radiations measured by the iontoquantimeter.

(3) The corresponding blackening of the film.

APPLYING THE SAFETY LIMIT TO ROENTGENOGRAPHY

The problems we have to face therefore are (1) how to arrive at a measurement of

* Dental films are coated on one side only. If these are used for testing, two of them superimposed give the same readings as duplitized films.

the quantity of radiations that can reach an operator during diagnostic roentgen-ray work, and (2) how to determine the amount of protection necessary to reduce this quantity to 0.00028 U.S.D. as the maximum possible daily exposure. With this end in view, we have made numerous readings of both the primary and scattered radiations under average conditions of roentgenography and screening. It does not follow that the results we have obtained are necessarily correct for other installations, but we believe that the conditions of our tests in a busy department are quite average technique and that our deductions, subject to corroboration from other sources, can be of use to others, even if the conditions vary materially from our own. It is to cover possible variations that we have made so wide a margin (i.e., $^1/_{25}$ of the dose we know to have been tolerated).

Quantity of Radiation Employed in Roentgenography. Records of the chief roentgenographic room of the Manchester Royal Infirmary show that this room deals with a daily average of 22 patients, using 35 films (maximum 50 patients with 80 films exposed). The total daily average time of operation of the roentgen-ray tubes is two minutes thirty-five seconds (3,8-5 milliampere-seconds). The maximum daily operation of the tubes recorded over several weeks' work was four minutes four seconds. This figure is surprisingly small but it shows an average of 4.4 seconds per exposure, which is accounted for by the large number of abdominal and other heavy cases in which the Potter-Bucky diaphragm is used.

Two tubes are used in this room, i.e., a gas tube and a hot cathode tube. On comparative readings under working conditions (0.124 Å., measured with 10 cm. sphere gap, and 25 ma.), we found that the gas tube was 10 times, and the hot cathode 11 times more active in discharging the electroscope, than the control tube which was giving our unit skin dose in eight minutes under standard conditions.

From this we calculated that the actual quantity of radiations produced in this room each day during the average exposure of two minutes thirty-five seconds would be 3.4 U.S.D. under standard conditions. i.e., 9 in. from cathode.

Only a thoughtless and negligent roentgenologist would today allow a roentgenographic assistant to be in the direct line of the rays. Common sense indicates that the tube, even if protected, should be directed away from the operator. Nevertheless, let us assume that the operator is entirely unprotected and in the direct line of the rays during the whole of the exposures. Then the following table shows the effect of the protection value of distance from the roentgen-ray tube and also of interposing various thicknesses of lead.

It seems therefore that the following

THE EFFECT OF DISTANCE AND FILTRATION ONTHE INTENSITY OF RADIATIONS USED IN RADIOGRAPHY.

Distance from X Ray Tube	Direct Radiation. Possible daily maximum	This is cut down by lead filters :—	Effect of lead filter					
			1/4 m.m.	1/2 m.m.	3/4 m.m.	1 m.m.	1 1/4 m.m.	1 1/2 m.m.
9 inches	3.4 U.S.D	" "	-	-	-	-	-	-
4 feet	.120	" "	.0042	.0012	.00042	.00019	.00009	.00005
6 feet	.053	" "	.0016	.00053	.00019	.00008	.00004	.00002
8 feet	.030	" "	.0011	.00030	.00011	.00005	.00002	.00001
12 feet	.013	" "	.0004	.00013	.00005	.00002	.00001	.000005

Figures beyond the line are lower than the safety limit which we have laid down as a daily dose of 0.00028 U.S.D.

For the use of the graph (Fig. 2), from which these figures are calculated, we are indebted to G. W. C. Kaye of the National Physical Laboratory. Our own figures corresponded very accurately with this graph up to 0.5 mm. Beyond this, however, we did not go as our instruments were not sensitive enough to insure accuracy.

thicknesses of lead or their equivalent are sufficient to give protection with an adequate margin of safety even for a roentgenographer who persistently, and in ignorance, works in *front of the anticathode* and therefore in the direct line of the primary beam.

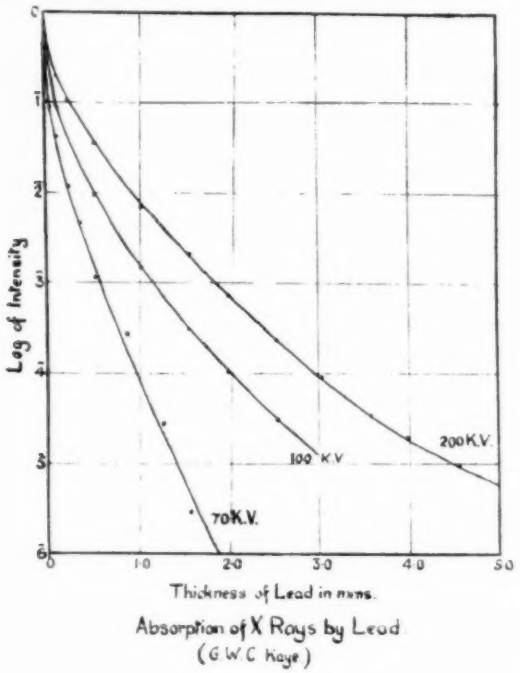

FIG. 2.

0.5 mm. lead is sufficient at a working distance of 12 ft.
0.75 mm. lead is sufficient at a working distance of from 6 ft. to 8 ft.
1.0 mm. lead is sufficient at a working distance of 4 ft.

Secondary Rays in Roentgenography. If however, the operator is behind the anticathode, as he should be, he is only exposed to secondary radiations. These also we have measured.

The quantity of secondary rays varies with the type of tube box used and the size of the aperture. For our tests in the roentgenographic room the tube was in an open lead glass bowl, with the cathode stem projecting, and a wide open aperture.

The conditions were those of actual practice, except that we had no patient, and only the couch top on which to scatter our primary beam.

The total quantity of secondary rays produced in a day's roentgenographic work is very small. In the room in which we made these tests, (size 18 × 16 × 12 ft. high) we obtained readings with the sensitized iontoquantimeter indicating that the total quantity was 0.00006 U.S.D. for a day's work at 8 ft. from the tube, this being the ordinary position of the operator for whom we had, of course, provided a well-protected shelter when the department was built.

Sources of Secondary Radiation. On another outfit and under rather different conditions, we have made a number of measurements while patients were being treated to determine what proportion of these secondary and other rays came from the patient, and what proportion by escape of rays through the open top of a most inadequate and antique tube box.

These figures were complicated by the primary rays arising from the cathode stem which extended outside the tube box. Our figures showed the following:

20 per cent originated from scattered and secondary rays from the open top of the tube box.
30 per cent originated from the cathode stem protruding beyond the protection.
50 per cent originated from the patient.

With a deeper tube box and one that was large enough to take in the active length of the anticathode stem, i.e., a half of it, these figures would be greatly changed; a much higher proportion of a smaller total would be due to secondary radiation from the patient.

The conditions of these experimental tests were as nearly as possible those of actual working conditions, and we believe that these do not differ materially from the accepted practice in other centers.

DEDUCTIONS AS TO ROENTGENOGRAPHY

We are therefore of the opinion for roentgenographic work:

(1) That distance from the active tube, whether adequately protected or not, is the essence of safety.*

* The possible danger to patients and others in rooms below or above a roentgen-ray department is frequently raised. Taking 12 ft. as the probable distance from the tube to the endangered person in the room below we find that: 3.4 U.S.D. at 9 in. is reduced to 0.013 U.S.D. at 12 ft., i.e., if there was nothing but air between the tube and the patient it would take seventy-seven days to deliver a U.S.D. But practically all these rays will be filtered through a patient's body and the floor materials, i.e., at least equal to 1 mm. lead. The probable time of a U.S.D. must therefore be in the region of 130 years. Out of curiosity we placed photographic films in the basement below various installations and all of them were unaffected in a month. We applied the same test to the basement directly below the deep therapy apparatus. Just the very faintest change could be detected after a month's exposure, but the floor of these rooms is ferro-concrete. A very rough estimate indicates a period of perhaps four years for one U.S.D. under our deep therapy apparatus at 12 ft.

(2) That the tube box for roentgenographic work need not be of greater protective value than 1 mm. of lead to give perfect safety even to an ignorant operator who works with the anticathode directed towards him, and who may be forced to work within 4 ft. of the tube.

(3) That it is unnecessary to use a completely enclosed tube box since the total quantity of secondary rays produced is practically negligible, and total enclosure only reduces by 50 per cent.

(4) That, if a protective screen for the operator is used, $\frac{1}{8}$ mm. lead will cut down any scattered or escaping radiations by roughly 80 per cent and is therefore ample for the purpose.

(5) That it is unnecessary to incorporate protective material in the walls or doors of a roentgenographic room of reasonable size, i.e., any room that is suitable for this class of work. Even a dark room wall next to a roentgenographic room needs only about 0.5 mm. lead to save risk of fogging.

APPLYING THE SAFETY LIMIT TO ROENTGENOSCOPY

Quantity of Radiation Employed. It is comparatively easy to obtain approximate figures for roentgenography, but for roentgenoscopy and its accessory service of plate taking during screen examinations, it is not possible to arrive at anything more accurate than a rough estimate. The novice not only makes prolonged screen examinations, but uses a wide open diaphragm quite unnecessarily. The expert makes his observations rapidly, and always uses the minimum diaphragm opening, and it cannot be too strongly emphasized that the use of the smallest practicable pencil of rays is the controlling factor that limits the risks of the observer.

Taking the screening service of the Manchester Royal Infirmary we have a weekly average of 58 gastrointestinal examinations, 30 chest cases and 3 foreign bodies. Our proportion of screen work, and time absorbed in screening each case, is probably well above the average.*

Working then on this basis, which is a very liberal one, and is, purposely, generous on any doubtful points, we have a daily period of thirty-two minutes during which the observer will be in front of the active roentgen-ray tube. Working at 0.124 Å and 4 ma., the tube was found to be 4.4 times more active in discharging the electroscope than the control which gives the U.S.D. in eight minutes at 9 in. Therefore, if we measured the quantity at 9 in. from the tube used in roentgenoscopy, we have 17.6 U.S.D. per daily exposure of thirty-two minutes. But since the minimum possible distance of the observer from the tube is 20 in. this quantity is cut down to at least 3.6 U.S.D. daily.

Effect of Filtration on the Primary Beam. At our minimum possible working distance for screening, i.e., 20 in., this quantity becomes:

0.111 U.S.D. when 0.25 mm. lead* or its equivalent is interposed.
0.036 U.S.D. when 0.5 mm. lead* or its equivalent is interposed.
0.006 U.S.D. when 1.0 mm. lead* or its equivalent is interposed.
0.0014 U.S.D. when 1.5 mm. lead* or its equivalent is interposed.
0.00039 U.S.D. when 2.0 mm. lead* or its equivalent is interposed.
0.00013 U.S.D. when 2.5 mm. lead* or its equivalent is interposed.

It appears therefore that a completely enclosed tube box of 2 mm. lead equivalent is adequate to give the necessary degree of protection.

The same figure of protective value is the obvious one, if it is practical, for the lead glass of the fluorescent screen, but there is no need to leave any margin of safety since, in screening, there is necessarily a patient in position, and the protective value of this added filtration is in itself usually equal to 0.5 mm. lead for

* The following are the figures on which these results are based. The times were obtained by observation of several workers doing the routine examinations. A recording clock was placed in the circuit of the roentgen apparatus and the figures give the average readings.

1st day gastrointestinal examinations	26 at 4 minutes each
2d day gastrointestinal examinations	21 at 2 minutes each
3d day gastrointestinal examinations	10 at 1 minute each
4th day gastrointestinal examinations	1 at 1 minute
Chest cases	30 at 1 minute each
Foreign bodies	3 at 1 minute each

To the exposure in screen examinations is added the following for exposures during the taking of films in the course of the examination:—

91 films, average $\frac{1}{8}$ exposure = 12 sec. total.

The average intensity of this is 10 times our standard, and under the conditions of our work equals two minutes' screening.

* The percentage absorption of the lead is again obtained from the lead absorption curve (Fig. 2).

abdominal examination and 0.25 mm. for the chest.* Moreover the distance is never anything like 20 in. in practice. It is very seldom so little as 30 in. and more usually nearer 36 in. between the target and the observer.

Secondary Radiations in Roentgenoscopy. To arrive at an estimate of the quantity of secondary radiations the measurements were necessarily an approximation based on electroscopic readings taken during actual examinations.

Other things being equal, the quantity of secondary radiations depends on the size of the beam of primary rays used in the examination, i.e., on the skill, or otherwise, with which the operator controls the diaphragm. We purposely used a large diaphragm opening during these tests, i.e., produced more secondary rays, than we should do under normal working conditions.

Upright Screening. Using a fluorescent screen that is adequately protected with lead glass as regards the direct beam, the electroscope shows that the quantity of secondary radiations is much more abundant at the sides than directly in front of the fluorescent screen. This fact adds to the safety of the operator when the patient is standing before the screen.

Couch Screening. The reverse in the case, however, when he examines a patient lying on the couch, for all the stream of secondary rays, coming from the patient strikes his own chest and abdomen.

Using a tube box of 3 mm. lead protection, but with a wide open diaphragm, we have made measurements at the point where the observer would be standing during an examination of a patient on the couch.

Allowing that half of the total screen examination (thirty-two minutes) is done on the couch, we get sixteen minutes as a daily maximum of screening with the patient lying down. From our measurements with the iontoquantimeter, we calculate that this would give 0.0006 U.S.D. from the secondary rays during the sixteen minutes' exposure beside the couch. Even without the quantity to which he is exposed in front of the upright screen stand, this is about twice the value of the safe limit that we have laid down (0.00028 U.S.D.). Neither the protective material of the tube box nor the use of a lead screen on the side of the couch can give adequate protection for practically all this radiation comes from the patient's body and strikes the observer's chest and abdomen. The only way to guard against this would be side flaps on the fluorescent screen, which would be impossible since palpation could not be employed. We therefore regard the wearing of a roentgen-ray proof apron as very highly advisable though not absolutely imperative for all couch-side screening work. The electroscope indicates that even so little as $\frac{1}{8}$ mm. lead equivalent is ample for such aprons, since it reduces the possible incidence of the rays to a fraction that is far below the danger limit.* If anyone doubts the dangers of screening beside a couch, let him note, with the screen, the secondary radiation coming towards him from the patient's flanks when he has the diaphragm wide open. It is also instructive to note how effective is $\frac{1}{8}$ mm. lead in cutting off the rays which produce this illumination. Even more telling is the blackening of a dental film which has been worn in a waistcoat pocket by the observer who does the work.

DEDUCTIONS AS REGARDS ROENTGENOSCOPY

Distance, the fool-proof safety factor, cannot be utilized in roentgenoscopy. More-

* A roentgen film fixed to the lead glass of the screen during a heavy day's work should be developed and compared with the scale reproduced in Figure 1. The lead glass used by the writer is only equal to 0.5 mm. lead, yet the films of his tests are very little blackened. This is probably because he uses a small diaphragm. Although our figures show 2 mm. lead as the correct protective value, we are confident that even when there is possible incompetence, a very much smaller protective value is adequate for perfect safety except in those departments where the work is incessant with 30 or 40 screen examinations a day. High value protective lead glass is very expensive and for movable screens for couch work is so heavy that it hampers work. For this purpose at any rate we are confident that 0.5 mm. value is sufficient, for the observer's face is seldom in the direct line of the rays as he is standing to the side of the couch and does not, as a rule, get his face right over except when searching for, say, a foreign body.

* Roentgen-ray proof aprons of the ordinary type hang unused in roentgen departments from years end to years end because of their weight. From our measurements it seems quite obvious that the heavy protection afforded, and their impractical weight are unnecessary. Some years ago we had a new type of apron made out of a single sheet that covers back and front down to the thighs, and consequently is balanced on the shoulders. It is slipped over the head and is left open at the sides. There is no protection for the arms. Smocks of this type affording 0.25 mm. lead protection (cutting off about 97 per cent of the scattered radiations) weigh $9\frac{1}{2}$ lb. We ourselves use the same article made in $\frac{1}{8}$ mm. lead, and this weighs only $4\frac{1}{2}$ lb. We are quite satisfied that it is ample protection for our conditions—it nearly obliterates the illumination of the screen from the scattered rays. The absorption figures show that it reduces these by about 88 per cent. Tests with dental films under these smocks confirm this view.

over, the observer is in the direct line of the rays. Nevertheless, roentgenoscopy can be rendered safe, provided:

(1) That the tube is completely enclosed in protective material of not less than 2 mm. lead equivalent.

(2) That the diaphragm be of not less than 2 mm. lead equivalent and of the adjustable rectangular type.

(3) That the lead glass of the screen, or an outward extension of similar protective value be large enough to catch the whole of the primary beam when the diaphragm is fully open. Theoretically it should be of the same protective value as the tube box and diaphragm. In practice, however, thanks to the protective value of the patient's body and that the distance is at least 30 in., we do not consider more than 1 mm. lead necessary for reasonable safety, even if the observer remains in his place while roentgenograms are being taken (as the writer has done for the last twenty years).

(4) That when using a totally enclosed tube box the dangers in front of the upright screening stand from secondary radiations are very slight, if not negligible, as compared with those to which the observer is exposed when he examines patients on the couch.

(5) That protective screens on the side of the couch only reduce the secondary radiations by a fraction, i.e., the massive screens fixed to the side of the couch are valueless as a protection against secondary radiations and superfluous for primary radiations if the tube box is of the totally enclosed type and of adequate protective value.

(6) With the iontoquantimeter placed in the position of the observer, its rate of discharge is cut down 8 times, i.e., 88 per cent of the radiations are cut off, by surrounding it with a light lead rubber apron of $\frac{1}{8}$ mm. lead equivalent. Two layers of loose blanket reduced these secondary radiations by 10 per cent, which we interpret as the protective value of the observer's clothes.

(7) To incorporate protective material in the walls of roentgenoscopic rooms is not necessary for the safety of passers-by or even those who may constantly work on the other side of the wall. If a dark room is next door it is advisable to add some protection to the walls for the safety of the film stocks.

(8) The protection of the observer's hands during screen examinations has been dealt with elsewhere.[2]

BLOOD CHANGES

For many years past, roentgenology has been regarded with suspicion as a possible source of danger. The death of every roentgenologist is called in question and natural causes are only accepted grudgingly. There is a lurking fear that these rays may yet bear death in forms that we do not understand. We look for circumstantial evidence of data in common between those deaths that do occur—every unexplained feature is whispered about as probably "due to his work," "not unlike the death of so and so." Surely the time has come, after all these years of suspicion to investigate things with an open mind. For instance, so far as we know, only one death is supposed to have been due to aplastic anemia resulting from roentgen-ray work, all the others having occurred in radium workers. To infer, if not to actually place roentgen rays and aplastic anemia in the relation of cause and effect in this case at least is certainly open to question, for not only were the conditions of work far from ideal in every particular but, in addition, there was a known chronic infection.

How many of the blood changes that were found, say, eight years ago have turned out to be anything serious? Have any of these changes been found when reasonable ventilation and other conditions were the lot of the worker?

The effect on the blood of massive doses of high voltage roentgen radiations and of radium even in small quantities is quite definite but we have considerable doubt as to whether the comparatively infinitesimal quantities of radiations to which the roentgen-ray worker is exposed in the course of his diagnostic work can have any influence in producing serious changes in the blood.

Mottram's striking paper[3] in 1920 on the blood changes in those who worked

with radium caused us to have blood tests made of all the workers in the roentgen-ray department of the Manchester Royal Infirmary where at that time the conditions of work were far from ideal. We had numerous tests made from time to time but none of them suggested that our staff was working under conditions of danger. Eventually, as the tests on all the workers gave negative results, they were abandoned. The two workers who were most exposed and whose radiation risks have been assessed (see page 553) had however the advantage of fresh air, the operator always working beside an open window and the roentgenologist moving about constantly in an open car from department to department.

In all the medium voltage treatment that we have carried out in the last twenty years or more, we do not recollect a single case in which we noted the onset of anemia or anything that indicated a blood count. Many of these patients were under treatment for very long periods and in the aggregate must have received an immense dose of primary and quite a substantial quantity of secondary radiations, since no precaution was taken at any time to cut them off from the patient.

If such large quantities of radiation can be tolerated without any clinical suggestion of blood change it is hardly logical or just, unless other and more likely causes are eliminated, to attribute the indefinite changes that have been found from time to time in roentgen-ray workers to the effect of the very small quantities of rays they have received as compared with the enormous doses tolerated for years by patients undergoing treatment. We are, therefore, of the opinion that the very rare cases of blood changes in roentgen-ray workers, are due to some other influence, most likely the effect of vitiated air, lack of fresh air and other conditions which inevitably accompany work in the obviously inadequate and ill-ventilated housing that has only too frequently been the lot of the roentgen-ray department in the past.

Our opinion is becoming stronger and stronger that there are not necessarily any risks attached to roentgen-ray work *provided* the roentgenologist is suitably equipped both as regards apparatus and accommodation. In a modern department, with reasonable air space, etc., there is certainly nothing as regards radiation risks, so far as we can measure, to suggest that ordinary operatives should be placed on a different footing from other hospital workers in hours of work or holidays. Some of the old departments were not fit for any person to live and work in—it is useless to legislate for such places for they should be scrapped at sight.

There is, however, one worker whose claim to special treatment we would persistently urge. In spite of the best intentions, the dark room can never be healthy and this worker should have special hours and holidays.

MEASURING THE SAFETY LIMIT IN PRACTICE

The object of our research has been to find, if possible, a definite foundation, a tolerance dose, on which to base protective measures in the *diagnostic* roentgen-ray services only. We believe we have succeeded, and out of our observations, if they are corroborated from other sources, we think that it will now be possible to evolve an ionization or photographic test* that will tell whether the average position of the operator is or is not one of safety under normal working conditions. A test of this type, in addition to its simplicity, would at once reveal the presence of leaks in the protective armour, for it is the weak links in the chain that are the danger. Apart from the accidents due to the wanton exposure of ignorance in the early days it is probable that the many tragedies that have occurred have been due to chance exposure to the primary beam through leaks and not to deficiency in the strength of the armour. To be effective the protection need not be great, but it must be complete. Leaks and weak spots will be just as dangerous with

* Fifteen members of a local society of roentgenographers have kindly submitted films that they have worn during an ordinary day of routine work. On development of the films we find that: 6 are well within the safety limit; 5 are on the border line; 4 are far beyond what we should regard the limit of safety.

All those working within the safety limit and those on the border line were using modern apparatus. Of the bad results, 2 were in workers whose conditions of work were bad and where there was no qualified roentgenologist in charge. The apparatus itself was reasonably good. One of the worst results was obtained from a worker in a modern and exceedingly well-equipped diagnostic department where, on the surface at any rate, the protective measures were carried almost to excess. One film was from a worker in a skin hospital. For more than twenty years it has been the habit of this worker, assisted by nurses, to hold restless ringworm patients during the whole of the exposure—the cubicles inside which he worked were perfectly protected! All these bad results were in the region of 3 times the safety limit.

massive as with light but effective protection. We very much doubt if anyone could be harmed in practice, if so little as 0.5 mm. of lead was always interposed as the following simpler figures indicate:

Distance, In.	Time for U.S.D. Unfiltered, Min.	Time for U.S.D. with 0.5 mm. Lead Interposed
9	8	13 hr. 40 min.
20	39.5	2 days 17 hr. 50 min.

COMPARISON

So far as we are aware this is the first attempt to arrive at a tolerance dose from recorded observations on the human subject as a basis for protective measures. Mutscheller,[4] however, has assumed that $\frac{1}{100}$ or 0.01 U.S.D. sustained in thirty days is harmless. Our estimate, stated in a similar way shows that 0.008 U.S.D. in thirty days is harmless. Glocker and Kaupp,[5] and Glocker[6] have based their investigations on the working hour, assuming that 1.0 U.S.D. in 1000 hours will be safe. We carried out our investigations in entire ignorance of their calculations, and it is a very striking fact that our deductions, arrived at by such different methods, should approximate so closely those of these three workers.*

* In the following table we have attempted to compare results:

Mutscheller	Glocker	Our Figures
$\frac{1}{100}$ U.S.D. in 30 days 0.00005 U.S.D. per working hour 0.00033 U.S.D. per day	1 U.S.D. in 1000 working hours 0.0001 U.S.D. per working hour 0.0005 U.S.D. per day	0.00005 U.S.D. per working hour 0.00028 U.S.D. per day
A working month being roughly 200 hours	No estimate of the number of working hours per day is given. Our estimation of 5 hours is applied for the sake of comparison	Taking a working day as being roughly from 4 to 6 hours

The following table gives the protective figures arrived at:

	Roentgenography	Roentgenoscopy
Our figures	1 mm. lead	2 mm. lead
Mutscheller	1.2 mm. lead	1.8 mm. lead
Glocker	1.5–2 mm. lead	2 mm. lead

CONCLUSIONS

It will be seen that our conclusions do not differ very widely from the recommendations of the English Radium and X-ray Protection Committee as regards roentgen diagnostic work. They seem to indicate, however, several points in which it is likely that these go beyond what is necessary.

Our conclusions as to roentgenography will be found on page 556 and those as to roentgenoscopy on page 558.

In framing protective measures we believe that our conclusions may, if corroborated, be used as a basis. No system of protection can however render roentgen-ray work fool-proof; any attempt to cater to folly must fail, yet it inevitably places a very serious handicap on the progress of roentgenology. We suggest that the first protective measure should be that no person be allowed to use a roentgen apparatus who is ignorant of electrical and radiation dangers and how to avoid them.

We wish to acknowledge our indebtedness to Prof. W. L. Bragg for suggestions and also for providing facilities for the preliminary calibration work and to G. W. C. Kaye of the National Physical Laboratory for pointing out fallacies and for granting the use of the lead absorption curve from which our figures are calculated.

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Publishers. PAUL B. HOEBER, INC., NEW YORK

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 1909 Massachusetts Ave., N. W., Washington, D.C. Office of publication, 76 Fifth Avenue, New York.

Information of interest to all readers will be found on page ii.

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EDITORIAL

HODGKIN'S DISEASE OF BONES

IN 1832, Thomas Hodgkin of London reported seven cases in which he had found enlargement of lymph glands, spleen and liver, and a secondary type of anemia; all of these cases had terminated fatally. The condition which he described was really a clinical syndrome rather than a pathologic entity. In 1845, Virchow identified the leucemias and separated Hodgkin's original cases into leucemic and aleucemic groups. In 1865, Cohnheim separated from the group the pseudoleucemias, a condition having the histopathologic findings of lymphatic leucemia without the characteristic blood findings. In 1893, Kundrat described lymphosarcoma and separated it from Hodgkin's group of lymphadenoses. Sternberg, in 1896, and Reed, in 1902, finally gave accurate descriptions of the histopathology of the disease that we now recognize under Hodgkin's name.

The original group has therefore been separated into leucemia, pseudoleucemia, lymphosarcoma and Hodgkin's disease. There is now a tendency among certain investigators to recombine them into a single disease and to add others such as mycosis fungoides and even multiple myeloma. It is asserted that Hodgkin's disease is occasionally changed into leucemia and also lymphosarcoma. The present classification is based upon differences in histological structure and must form the only basis for classification until something is known of the etiology of these conditions. With regard to the latter, there are theories but still very little proof. Sternberg believed that the disease was tuberculous and although he afterward modified his views and admitted that there is probably a non-tuberculous Hodgkin's granuloma and the general opinion now favors a non-tuberculous etiology, there are still many facts which favor the theory of a tuberculous origin of the disease. The diphtheroid group of bacilli called *B. hodgkini* have been isolated frequently but not constantly from lymph nodes in Hodgkin's disease, but they are also present in numerous other diseases.

There is rather general agreement that the disease is an infectious granuloma and not a neoplasm although many investigators are still unconvinced on this point. Mallory, for instance, believes that the disease is a lymphoblastoma. Even those who classify the disease as an infectious granuloma recognize the fact that there are certain cases of Hodgkin's disease which are invasive and thus present characteristics of sarcoma. Ewing classifies such cases as Hodgkin's sarcoma in distinction to true Hodgkin's disease which does not exhibit invasive tendencies.

The disease now classified as Hodgkin's disease has the following clinical manifestations. It sometimes begins with cutaneous symptoms such as itching and eczematous eruptions but more often the first sign of the disease is enlargement of a chain of lymph nodes, the cervical, axillary, inguinal or mediastinal. Enlargement of the spleen and liver are frequent early occurrences. When the disease becomes widespread, fever, night sweats, anemia and cachexia develop. Mediastinal involvement is often accompanied by dyspnea and substernal discomfort. Pain in various parts of the body, depending upon the distribution of the lesions, is not infrequent, and paraplegia occasionally occurs when the spinal canal is involved.

Final diagnosis usually rests upon histological examination. The structure of typical Hodgkin's granuloma is characteristic and is described by Ewing as follows:

"It consists of a reticulum in which lie a few small lymphocytes, large lymphocytes, plasma-cells, eosinophile cells proliferating endothelium, and endothelial giant-cells. There

are many variations in the proportions of these cells. In the early stages lymphocytes are abundant, but follicles and sinuses are soon obliterated. The nodes on the outskirts of invaded chains may show a simple hyperplastic lymphadenitis, but the specific process attacks the supporting tissue and endothelium and seems to cause little hyperplasia of lymphocytes. Later the lymphocytes largely disappear with the multiplication of other cells. Endothelial proliferation is prominent from the first, so that large, loose, rounded cells with clear cytoplasm and single or multilobed hyperchromatic nuclei are an important diagnostic feature. These cells may increase in size and number so that they may compose the bulk of the tissue. When in excess they may appear as large, flat, almost pavement-like cells, or as a collection of giant-cells, or as a diffuse growth resembling sarcoma. They long resist the advance of fibrosis.

"Eosinophile cells are usually numerous, sometimes extremely abundant, occasionally absent. They are mononuclear or polynuclear, and they probably arise as a result of small extravasations of blood which mark the early lesions. A peculiar brownish-yellow color of the Hodgkin nodes on section may, perhaps, be connected with this tissue eosinophilia. Polynuclear neutrophile cells are not prominent. A few plasma-cells are regularly present, and they may become so numerous as to lead to the designation of plasmoma. Necrosis is missing in the characteristic stages of the process, but in acute febrile cases, and in old and bulky lesions, there may be focal or extensive necrosis. Fibrosis becomes established in many advanced lesions and acellular connective tissue in bands and masses composes a considerable portion of certain bulky tumors.

"Apart from the specific structure presented by typical stages of the process and the variations which are readily derived from it, the scope of this granuloma is difficult to determine. Very early lesions are often typical and the terminal stages are commonly recognizable. Beside the typical picture described by Sternberg and Reed, characteristic cases may be associated with pure lymphoid hyperplasia, various forms of proliferation of reticulum cells, as well as with subvarieties of tuberculosis (cf. Endothelioma of Lymph-nodes)."

It has long been recognized that the bone marrow is involved in the pathologic process of Hodgkin's disease, in addition to the lymphoid structures of the body. Some investigators believe that the bone marrow is affected in all cases of the disease and some suggest that it may become involved even before the lymph glands. It has been only in recent years, however, that it has been recognized that Hodgkin's disease may produce bone lesions simulating bone tumor or osteomyelitis. Montgomery has recently reported such a case in a boy nine years of age with involvement of the spinous process of the second cervical vertebra and the middle third of the right tibia. In commenting upon this case Montgomery states that "the pathological lesion in the bones may be either a granulomatous periostitis, accompanied at times by the formation of osteophytes; or there may be rarefaction of the bone, leading sometimes to pathological fracture." The fact that many different bones have been reported involved in Hodgkin's disease including the vertebrae, tibia, fibula, sternum, skull, humerus, clavicle and the ribs makes it "seem advisable in every case of Hodgkin's Disease to make a röntgenological examination of the entire skeleton."

Roentgenologists are especially interested in Hodgkin's disease because they are frequently called upon to apply radiation treatment to the lesions in various parts of the body and to assist in diagnosis when the lesions are within the chest. The fact must also be kept in mind that the disease may involve bones, and it seems probable that this is a more common occurrence than the cases hitherto reported would lead one to believe.

For those interested in reviewing our present knowledge of this still comparatively obscure disease, the following are references to recent literature.*

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SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Twenty-ninth annual meeting, Hotel President, Kansas City, Mo., Sept. 25–28, 1928.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Minneapolis, Minn., June 13, 1928.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Minneapolis, Minn., June 11–15, 1928.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Fourteenth annual session, Chicago, Ill., Dec. 3–7, 1928.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.
Next annual meeting, Asheville, N. C., Nov. 12–15, 1928.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. James H. West, 8314 Euclid Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. O. J. Shore, 2033 Park Ave.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. Carl S. Oakman, Muncie, Indiana.
Annual meeting each February 22 in Indianapolis. Next meeting in June, 1928.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Annual meeting, Galveston, Texas, 1928.

VIRGINIA ROENTGEN RAY CLUB
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Annual meeting Oct. 17, 1928.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winterat 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION
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Next annual meeting, Charlottetown, P. E. I., June 21–23, 1928.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

CONTINENTAL EUROPE

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prague, II/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.
Next meeting with the Gesellschaft deutscher Naturforscher und Aerzte will be in Hamburg, Sept. 16–21, 1928.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT
Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1928.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.
Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Secretary, Dr. H. Scheuermann, Copenhagen
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

FEDERATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN THE CZECHOSLOVAKIAN REPUBLIC

The sixth meeting of the Federation was held in Prague, October 29 and 30, 192-. The presiding officer was Dr. Jaksch-Wartenhorst and the business manager Dr. Altschul.

The dean of the medical faculty, Professor Biedl, greeted the assembly and emphasized the fact that medical faculties will have to seriously consider the question of instruction in roentgenology. The chairman read obituaries for the deceased member Dr. Guth of Bokau, and the deceased chairman of the Czechoslovakian Roentgen Society, Professor Jedlicka.

The following honorary members were

elected, Dr. Haudek of Vienna and Dr. Wintz of Erlangen.

ROENTGEN DIAGNOSIS AND ROENTGEN THERAPY OF EXTRAPULMONARY TUBERCULOSIS

Kisch, Berlin, presented an extensive review of the development of radiation therapy of tuberculosis and reported on progress made in finding a substitute for high altitude light therapy applicable at low altitudes. The speaker obtained excellent results at Hohenlychen near Berlin with a combined sunlight and roentgen treatment in a large group of cases, and exhibited a series of illustrative roentgen pictures. Since not all of the patients could be admitted there, it was necessary to establish in the northern part of Berlin a dispensary for bone and joint cases, in which ambulant patients were treated according to the same principles and with equal success.

Wagner, of Prague, reported on the results of the roentgen treatment of female genital tuberculosis at the German Women's Clinic in Prague. In a total of 42 cases, excellent results were obtained in 10 and very satisfactory effects in 22 more. Small doses gave better results than large ones.

Palugyay, Vienna, also objected to high doses. He has obtained excellent results with very small doses in male genital tuberculosis. Especial weight is placed on the inclusion of the whole intrapelvic genital tract.

S. Schoenhof, Prague, discussed skin tuberculosis. Exudative forms of lupus react well to combined roentgen and corrosive treatment (25 per cent quinine salve; in mucous membrane lupus, lactic acid). The particular domain for roentgen treatment is scrofuloderma. Roentgen therapy represents effective means for augmenting the treatment of skin tuberculosis.

Herrnheiser and Braun, Prague, reported on favorable results in eye tuberculosis with striking results in 9 cases of choroiditis. The most favorable action is obtained by weak irradiation with fractional doses.

Altschul, Prague, discussing the recognition and differential diagnosis of bone tuberculosis showed that an atrophy confined to the vicinity of a joint is a typical accompaniment of tuberculosis, whereas other types of atrophy are due to other diseases, especially gout. The report then turned to the differential diagnosis of gonorrhea (early ankylosis) and lues (sharply outlined defects), and was closed by a demonstration of several unusual forms of tuberculosis.

Adler and Wotzilka of Aussig and Bokau, demonstrated roentgen pictures of tuberculosis of the larynx exhibiting thickening of the epiglottis, pronounced calcifications of the thyroid and cricoid cartilage and diminution in the air space of the trachea.

Following the above lectures there was active discussion participated in by the lecturers and also by Lahm of Chemnitz, Schütze of Berlin, Steiner of Teplitz and Gütig of Witkowitz.

ACCIDENT AND THE ROENTGEN RAY

Grashey, Munich, presented a review of roentgen findings in accident work. He showed with the aid of numerous roentgen pictures the difficulties that may be encountered in attempting to reach a diagnosis. It would be desirable to have a collection of as many pictures as possible of definitely established age in order to have reference roentgenograms when the question arises as to the age or duration of the sequel to the accident. The roentgenogram in accident work carries a peculiar responsibility.

Altschul, Prague, demonstrated that insignificant traumas may result not only in mild effects but also in very severe injuries. This is especially the case in indirect fractures of weak bony structures with strong muscle insertions, e.g., Schlatter's disease, fractures of the transverse, articular and spinous processes of the vertebrae. In rupture of ligamentous processes changes do not appear in the roentgenogram until later when scarring or calcification begins to occur. Among the secondary consequences of accident there should be included the various forms of atrophy.

In the discussion, Gütig showed the need for exact study of the roentgen pictures because frequently small fissures or fractures may be overlooked. Wagner

showed a protrusion pelvis apparently due to inflammatory processes and not, as was assumed, to mild trauma. Fritsch of Bielitz demonstrated a peculiar fracture of the rib. L. Pokorny, Komotau, reported a case of apparent post-traumatic arthritis of the shoulder in which the comparative roentgenogram of the other side in which no trauma was demonstrable showed exactly the same changes. Altschul mentioned the fact that such changes occur in syringomyelia.

THERAPY

C. Schoenhof, Prague, reported on distant effects following irradiations of the endocrine organs. After irradiation of the hypophysis amenorrhea occurred which, however, was not due to the irradiation but was an early symptom of Basedow's disease which developed subsequently. In a case of amenorrhea, a stimulative treatment resulted in the revival of a pulmonary process. In this case, the defense reaction set up by the body was torn down by the irradiation and reacted to the patient's detriment.

Lahm, Chemnitz, discussed the problem of the biological carcinoma cure with respect to differences between animal and human carcinoma. He emphasized that the carcinoma is a local disease and consequently must be combatted locally. Biological cure of carcinoma must be attacked from two angles: change of the cells to make them less malignant and defense against the local antecedent conditions in the body favoring development of the carcinoma.

Füllsack, Aussig, was unable to secure any pronounced results in his cases with Mayer's glucose therapy; in this connection, Schoenhof and Palugyay also could find no difference between cases treated with roentgen rays alone and those previously treated with glucose.

Jaroschka, Prague, by the administration of glucose could demonstrate no increase in tissue glycogen; on the other hand, after roentgen irradiation of the primary tumor there occurred a three-fold increase of glycogen, on the average.

Epstein, Aussig, emphasized that the roentgen treatment of leucemia should not be carried out in a schematic manner, but that in each case one should employ the smallest effective dose.

Bardachzi, Aussig, has obtained doubtful results with the mild irradiation of inflammatory complications in scarlet fever.

L. and A. Pokorny, Komotau, observed astonishing results after the roentgen treatment of 2 cases of hay fever.

RADIUM THERAPY

Heiner, Joachimstal, obtained very satisfactory results by treating cases of chronic nerve, muscle, joint and skin diseases having increased blood sugar level with a special diet devised by Dr. Max Adler of Karlsbad, and combined with radium irradiation. He has found, in fact, that those cases which present themselves with this metabolic disturbance are more amenable to the radium cure than cases with normal metabolism.

A. Pokorny, Komotau, demonstrated a radium ulcer occurring after an improperly administered radium treatment.

ABDOMEN

Weiner, Prague, reported from his wide experience on the various forms of developmental disturbances of the kidneys and ureters.

Joseph, Berlin, regards two roentgen symptoms as important for the diagnosis of kidney tumors: (1) the filling defect, and (2) the tremendous displacement of the kidney pelvis and ureter outwardly, a sign which was first described by him. While the first symptom may also be given by other diseases, the second symptom is pathognomonic for tumor. Götzl points out that this symptom is no early symptom and becomes useful only in the advanced stage.

Feist, Warnsdorf, observed on roentgen examination of an abdominal hernia with the patient standing upright, a diverticular projection of the stomach into the hernial sac. At operation (with the patient on the back) the hernial sac was empty and the stomach normal.

Herzog, Witkowitz, demonstrated a granulation tumor of the cecum as a result of a mild invagination.

Schütze, Berlin, demonstrated a case of

diverticulitis of the colon, a case of diverticulum in the lower descending colon, and also a case of bipartite diverticulum at the duodenojejunal flexure.

THORAX

Jaksch and Rihl, Prague, demonstrated a case of apple-sized aneurysm at the heart apex caused by syphilis. Dworak, Prague, reported a case of extensive heart *en cuirasse*, and Kissoczi, Prague, reported an aneurysm the size of a fist in the innominate artery, which presented considerable difficulty in the differential diagnosis from substernal struma.

Fritsch, Bielitz, showed a case of unusual right-sided diaphragmatic relaxation, and Herzog reported a case of partial relaxation of the diaphragm in conjunction with a mediastinal tumor.

BONES

Reiser, Prague, reported on a method for securing definite positions in difficult skull roentgenograms by means of auxiliary points and external marks suitable for representation of the optic canal.

Löw and Beer, Prague, reported on a method for roentgenographing the auditory system similar to the procedures reported in 1923 by Fischer and Sgalitzer. In this connection Herrnheiser demonstrated a device which simplifies and shortens the roentgenographic technique in photographing the ear.

Kuh, Prague, reported on diseases of the basal joint of the toe. The most common disease is arthritis deformans caused by over-strain of the foot. The roentgen pictures are characteristic and easily differentiated from similar pictures occurring in syphilitic arthritis, tuberculosis, rickets and trauma.

Jaroschy, Prague, reported on 2 cases of Renander-Müller's disease of the sesamoid bone of the large toe. In this disease there occurs a disturbance caused by mechanical and functional effects.

Schütze, Berlin, discussed Albers-Schönberg's "marble disease" in connection with a case. As a result of endosclerosis there occurs a narrowing of the bone marrow space and results in a vicarious activity of the rest of the hematological system. Thus in the case reported the spleen occupied almost half of the abdomen. There are four characteristic points in this disease: bone fragility, bone suppuration, growth disturbances and endosteal sclerosis.

Schiller, Wlaschim, showed a case of segmented exostosis in the knee joint, also roentgenograms of an osteomyelitis in the acute stage showing an entirely normal picture, while those taken two months later revealed the most acute bone changes.

Herzog demonstrated a case of gumma of the skull.

MISCELLANEOUS

Gütig warned against over-evaluation of the roentgen findings since an apparently clear finding may easily lead to neglect of important details of examination on the assumption that they are superfluous, and illustrated his remarks with examples. The discussion of this important theme was participated in by Porges, Reiser and Herzog.

Sgalitzer, Vienna, showed pictures, aiding in the diagnosis of cerebral affections, taken with the aid of iodized oil and especially important in sellar destruction of obscure origin.

Lahm, Chemnitz, demonstrated the roentgen pictures of postmature infants and indicated that it is possible to diagnose overdue birth roentgenologically from the advanced differentiation in the skeletal system. Kalmus, Prague, called attention to the importance of this contribution to medical jurisprudence.

Gurniak, Prague, reported a case of old gunshot injury which showed in the roentgen picture along the whole upper arm a chain of streaks and flakes of metal density. Histologically there was a foreign body granuloma, chemically there was demonstrated iron and lead. Füllsack demonstrated lime depositions in sepsis showing similarity to lime gout (deposits of lime in the skin of the tips of the fingers).

TECHNIQUE

Strauss, Vienna, demonstrated the most recent improvements in his roentgen Mekapion.

Fritsch, Berlin, reported on the elimina-

tion of high voltage danger in roentgen operation obtained with the Sekuro by means of which any contact of the human body with the current cuts it off immediately and automatically.

Jona, Vienna, demonstrated a new high output apparatus for diagnosis capable of standing a load up to 2000 ma. The exposure time is in hundredths of a second.

Buchsbaum, Karlsbad, demonstrated circuits for therapy and diagnostic apparatus.

Rigele, Prague, discussed the principles of roentgen stereoscopy and showed apparatus for stereoscopic transillumination, also a device for stereoscopic roentgenography having a capacity up to five pictures per second.

WALTER ALTSCHUL.

NATIONAL ELECTRICAL CODE TEXT FOR SECTION 5012 OF 1928 EDITION

5012. X-RAY AND HIGH-FREQUENCY APPARATUS

(*a*) Adequate mechanical barriers shall be provided to prevent too close approach to any high-voltage part except the operating tube and its leads, and it is recommended that all other parts be enclosed in a separate room or cabinet. Such barriers may consist of grounded metal or of insulating material such as glass. High-voltage parts enclosed in a wooden cabinet shall have adequate spacing from the wooden walls. If one side of the high-voltage circuit is grounded, the milliammeter shall be connected in the grounded lead, and need not be guarded. All operating parts such as spark gap handles and regulating handles shall be made of suitable insulating material and shall be operative from outside of the barriers.

(*b*) Overhead high-voltage stationary conductors shall be not less than 7 feet 6 inches above the floor where the ceiling height permits and in no case less than 7 feet. The high-voltage leads on tilting tables and fluoroscopes shall be adequately insulated or so surrounded by barriers that inadvertent contact with them is improbable. Tube terminals and high voltage wires connected thereto should be adequately insulated for a distance of 12 inches from the terminal. Shields for this purpose shall be designed to carry the high-voltage leads away from the patient in a direction at right angles to the long axis of the tube. X-ray tubes used in therapy shall be mounted in a grounded metal inclosure.

(*c*) The low-voltage circuit of a step-up transformer shall contain a manually operable automatic circuit-breaker having no exposed live parts. There shall be an additional switch in this circuit, which for diagnostic work shall be one of the following types:

(1) A switch with spring or other mechanism to open automatically except while held closed by the operator.

(2) A time switch which will automatically open after a definite time for which it has been set.

(*d*) Where more than one piece of apparatus is operated from the same high-voltage source, each shall be provided with a high-voltage switch so as to give independent control.

(*e*) Low-frequency current-carrying parts of machines of the quenched-gap or open-gap type shall be insulated or guarded so that they can not be touched during operation. This applies to all parts except the high-frequency circuit proper which delivers high-frequency current normally for therapeutic purposes.

(*f*) Transformers which are a part of an X-ray or high-frequency apparatus, even though they contain oil, are to be considered and treated as a part of the device, and need not conform to the requirements of Section 5005 for power transformers.

(*g*) All tube stands and fluoroscopes shall have their frames, operating handles, and other non-current-carrying metal parts of apparatus grounded in conformity with the requirements of Article 9. Non-metallic tables and chairs are recommended, particularly for therapeutic work. Metal or other conducting tables or chairs for supporting patients shall be suitably insulated from ground, and insulating floors, mats or platforms shall be provided for operators. It is recommended that floors

of concrete or other conducting material be completely covered with linoleum, rubber tile or other insulating material.

COURT OPINION

Dr. H. F. Waite of New York has sent to the Journal the following court opinion received by him from C. J. W. Meisel, counselor at law.

The opinion of the Court in the case of Gilbert vs. Klar, decided by the Appellate Division, Fourth Department, on March 28th, 1928, and reported in 223 App. Div., page 201, Advance Sheets of May 5, 1928, is as follows:

"Per Curiam. Appeal from an order directing plaintiff to appear before a designated doctor, who is roentgenologist at the Millard Filmore Hospital in Buffalo, N. Y., and to permit an X-ray 'photograph' to be taken of his right elbow. While the decisions of the State courts on the point are conflicting, we are of the opinion that the order should be affirmed. A physician or surgeon designated by the court or judge to make a physical examination of the plaintiff should be permitted, under such restrictions and directions as shall seem proper, to employ such means as are in common use in the profession. We may take judicial notice that the X-ray is in common use and that the science and art thereof have been developed to a point where, in the hands of specialists, there is little or no danger."

INVITATION TO VISIT PRAGUE

We note from the American Journal of Roentgenology that in connection with your trips to the International Congress you also have in view a visit to Prague. We therefore take pleasure in offering our services to help make agreeable your visit to Prague and request in this connection that you communicate with our business manager, Dr. Walter Altschul, Vladeslova 17, Prague II, who will surely be in Prague during the time of the meetings.

Respectfully for the Committee
JAKSCH.
ALTSCHUL.

For the committee representing the Association of German Roentgenologists and Radiologists of the Czechoslovakian Republic.

INVITATION TO VISIT ITALY

Prof. G. E. Pfahler, President,
American Committee, Second
International Congress of Radiology.
Dear Professor:

The Italian radiologists will be very pleased to receive the Americans coming to Italy on their way to Stockholm. I shall be at their disposal in my Instituto, Galleria Umberto 8 (Palazzo Banco d'Italia), to give all the assistance necessary for visits to the leading radiologists and the most important roentgen and radium institutes in all parts of Italy. I am sure that the Italian trip will be very enjoyable to your countrymen and will be the means of introducing them to the beauties of the country, its art treasures and the great progress made in the last years.

Very sincerely yours,
P. TANDOJA, President
Societa Italiana di Radiologia Medica.
Napoli, Italy.

INVITATION TO VISIT WIESBADEN

Professor Alban Köhler, Wiesbaden, honorary member of the American Roentgen Ray Society, would be very happy to greet the roentgenologists passing through West Germany on their trip to Europe and show them his Roentgen Institute. It is of course only a small private institute but contains many historically valuable objects and books from the very first years of roentgenology. Wiesbaden can be reached from Frankfurt a. M. in thirty-five minutes by express train.

COURSE FOR STUDY OF CANCER

Medical Faculty of Strasbourg: District Center for the Paul Strauss Anticancer Campaign.
Second Course of Advanced Study of Cancer
Organized
Under the Patronage of M. Paul Strauss, Senator and Former Minister of Hygiene
by

Dr. Gunsett, Lecturer of the Medical Faculty and Director of the Anti-cancer Center of Strasbourg with the Collaboration of the Teaching Body of the Medical Faculty:

Messrs. Borrel, professor of hygiene and bacteriology of the Faculty of Medicine of Strasbourg; Canuyt, professor of clinical oto-rhino-laryngology; Keller, lecturer of the Faculty of Medicine; Leriche, professor of clinical surgery; Oberling, lecturer in histopathology; Pautrier, professor of clinical dermatology; Reeb, lecturer of the Faculty of Medicine; Stolz, professor of clinical surgery; Vlès, professor of Physical Biology; Weil, professor of clinical ophthalmology.

The course will be given from Tuesday, October 16, 1928, to Wednesday, October 31, 1928, and will include:

A. Theoretical and Practical Courses on Cancer in the Different Clinics and Institutes of the Faculty of Medicine.
   I. At the Pasteur Institute of Strasbourg, Prof. Borrel. Two lectures on the etiology of cancer and the cultivation of tissues. Those who would like to practice the technique of cultivating tissues in Prof. Borrel's laboratory should apply directly to him.
   II. At the Oto-rhino-laryngological Clinic of Prof. Canuyt. Four lectures:
      1. Cancer of the nasal fossae and sinuses.
      2. Cancer of the nasopharynx; cancer of the tonsil; cancer of the lower pharynx.
      3. Cancer of the larynx.
      4. Cancer of the esophagus.
   III. At the Gynecological Clinic of Dr. Keller.
      1. The operative treatment of cancer of the cervix of the uterus.
      2. Demonstrations of curietherapy.
   IV. At Surgical Clinic A, Prof. Leriche. One lecture on cerebral tumors.
   V. At the Institute of Pathological Anatomy (Director, Prof. Masson); Dr. Oberling, 13 lectures:
      1. General disturbances of the growth of tissues. Proliferation of embryonic, hyperplastic and neoplastic cells. Principles of classification of tumors. Embryonic tumors.
      2. Tumors of stratified pavement epithelium.
      3. Tumors of cylindrical mucous membrane. Intestine. Stomach.
      4. Tumors of the breast.
      5. Tumors of the thyroid.
      6. Tumors of the kidney and urinary tract.
      7. Tumors of the uterus.
      8. Tumors of the ovary.
      9. Tumors of the testicle.
      10. Nerve tumors.
      11. Bone tumors.
      12. Tumors of lympho-hematopoietic tissue. Lymphosarcoma-myeloma-reticuloma.
      13. Biopsy—general technique—indications and results.
   VI. At the Dermatological Clinic, Prof. Pautrier. Two lectures on cancer of the skin.
   VII. At the Maternity Clinics, Dr. Reeb. Demonstrations of curietherapy.
   VIII. At Surgical Clinic B, Prof. Stolz. One lecture on tumors of the stomach.
   IX. At the Ophthalmological Clinic, Prof. Weil. One lecture on cancers of the eye.
   X. At the Institute of Physical Biology, Prof. Vlès. Some physico-chemical characteristics of the normal and pathological organism and their application to the problem of tumors.

B. Theoretical Courses and Practical Exercises in the Treatment of Cancer by Physical Agents. At the Anticancer Center under the Direction of Dr. Gunsett, Director of the Anticancer Center.
   1. Theoretical course with demonstrations by Dr. Gunsett.
      1. General information: Tubes and apparatus for roentgen therapy. Absorption. Filtration. Diffusion, etc.
      2. Quantitative measurements:
         A. French and foreign ionometers.

B. Units of measurement.
Solomon's unit, the unit of Dauvillier and the electrostatic unit.

3. Qualitative measurements.
   (*a*) Ionometric.
   (*b*) Spectrometric.
4. Methods of Application and Technique of Dosage at the surface and in the deep tissues.
5. Physical foundations of curietherapy.
   Methods of application.
   Methods of measurement and calculation of dosage.
   Units of Proust, Mallet, Colliez.
6. Some chapters in radiophysiology and radiopathology.
   (*a*) Radiosensitiveness and radioresistance.
   (*b*) The problem of stimulation.
   (*c*) Latent period and cumulation. Fractional doses and separated doses.
   (*d*) Radiodermatitis and radionecrosis.
7. Technique and results of treatment of some cancers.
   (*a*) Cancer of the skin.
   (*b*) Cancer of the cervix.
   (*c*) Cancer of the breast.
   (*d*) Cancer of the tongue and cancer in oto-rhinolaryngology.
   (*e*) Cancer of the rectum and other cancers.
   (*f*) Sarcomas.
8. Diathermo-coagulation and its application in cancer.

II. Daily presentation of patients (Dr. Gunsett). Cured patients, patients still under treatment, new patients. Discussion of the clinical course, laboratory examinations and plan of treatment. Placing the patients under the roentgen-ray apparatus.

III. Practical work and lectures on roentgen therapy and curietherapy. Under the direction of Dr. Gunsett with the collaboration of Mlle. Dr. Berg, assistant at the anticancer center, MMe. Ch. Spack, assistant at the anticancer center, Dr. Reiss, assistant in biological physics on the Faculty of Medicine, Dr. Sichel, assistant in radiology on the faculty of medicine, Dr. Spack, assistant at the anticancer center and Dr. Wolff, chief of the laboratory at medical clinic A. These practical courses will include:

1. Practical ionometry with French and foreign ionometers (Solomon, Dauvillier, Küstner). Standardization of ionometers and apparatus in French and electrostatic R. Transmission in the phantom. Qualitative measurement. Isodoses. Technique of deep dosage.
2. Practical spectrography and spectroscopy of roentgen rays with the aid of the apparatus of Seemann and Staunig.
3. Microionometry with the aid of Mallet's microionometer (usual manipulations and those of telecurietherapy).
4. The manufacture of apparatus modelled for external curietherapy (Regaud method).
   Every participant in the course will have an opportunity to use every one of these methods practically.
5. Lectures on physics, Dr. Reiss.
   The physics of roentgen rays.
   The physics of radioactive bodies and the physicochemical mechanism of action of waves of short wave length.
6. Lectures on hematology, Dr. Wolff.
   Hematology of cancer of skin and viscera.
   Histological and biological changes in the blood of cancer patients under the influence of treatment with roentgen rays and radium.
   Clinical course, diagnosis and treatment of these cases.

The course will end Oct. 31 with a day of public lectures and papers on cancer and its treatment followed by a discussion at Medical Clinic A.

Under the Presidency of M. Paul Strauss, Senator and Former Minister of Hygiene.

Questions to be discussed:

Cancers of the Mouth and Respiratory Tract.

Cancers of the thyroid.

The papers as well as the discussions will be published. Authors who wish to present a paper are requested to send the title of it before June 1 to Dr. Gunsett, director of the Anticancer Center, Civil Hospital at Strasbourg. The questions up for discussion do not exclude a discussion of other questions of current interest.

The following have announced their participation:

France: Prof. Berard, Lyon (thyroid cancer). Prof. Regaud, Paris (subject reserved). Dr. Belot, Paris (cancers of the skin and radioresistance of cancer). Drs. Coliez and Mallet, Paris (telecurietherapy). Dr. Dauvillier, Paris (ionometry). Gauduchaux, Nantes, S. Laborde, Paris) (subjects not announced). Dr. Solomon, Paris (standardization of ionometers).

Belgium: Prof. Bayet, Bruxelles (subject not announced). Prof. Dustin, Bruxelles (the cytological reactions of tumors treated by telecurietherapy). Drs. Coryn, Delporte, Cahen, Ledoux, and Leroix, Bruxelles (subjects not yet announced). Dr. Sluys, Bruxelles (cancer of the lungs.

Switzerland: Dr. De Coulon, Lausanne (subject not announced). Dr. Rosselet, Lausanne (radio-immunization).

The program for this day will be published later.

Subscriptions for the course will be received by Dr. Gunsett, director of the Anticancer Center, Civil Hospital, Strasbourg. The price of the course is 300 francs.

A certificate will be given the participants at the end of the course.

The number of participants is limited. A detailed schedule will be sent to the participants later, as well as information in regard to hotels, pensions, etc. There will be a banquet at the close of the course.

The Dean of the Faculty of Medicine,
President of the Administrative Council
of the Anticancer Center

Signed: WEISS.

The Director of the Anticancer Center
Signed: GUNSETT.

ALBERT M. COLE

Notice has been received of the death of Dr. Albert M. Cole of Indianapolis on June 3, 1928. Dr. Cole was an active member of the American Roentgen Ray Society for many years, although for the past few years illness has prevented his participation in the affairs of the Society. An account of his life and work will be published in an early number of the Journal.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

BISSELL, FRANK S. The rationale of gall-bladder diagnosis. *Radiology*, September, 1927, ix, 209–212.

Biliary diagnosis has been more accurately accomplished by means of artificial visualization of the normal gall-bladder, but direct visualization is necessary in certain cases. It is important to remember, however, that the diagnosis of biliary disease is not always an indication for operation. Such cases are often improved by careful management, and this improvement can be demonstrated by means of the roentgenogram. Co-operation between the internist and surgeon is necessary to prevent errors in diagnosis.

GOALWIN, HARRY A. One thousand optic canals. *J. Am. M. Ass.*, Nov. 19, 1927, lxxxix, 1745–1748.

This report is based on an investigation of 806 optic canals in living and 194 in dried skulls. The discrepancies between the sizes and shapes of the optic canal as reported by various observers are due to (*a*) measurements made at different points of a conically shaped canal; (*b*) observations that are made from varying angles, and (*c*) the use of roentgenographic dimensions without proper reduction.

In a series of 253 cases examined for 34 causes, 23 types of pathologic change of the optic canal were found in 35 per cent of the cases. In 50 per cent of the cases the cause was found elsewhere in the skull and in about 7 per cent a negative diagnosis was of clinical value. Judging from this series, skull deformity with optic nerve symptoms is fully twice as frequent in general ophthalmic practice as in optic nerve tumor.

Measurements of the direction of the axes of 1000 optic canals (806 in the living) in 500 skulls lead to the conclusion that there is no appreciable variation due to sex or racial stock. The average inclination of the axis of the optic canal in the normal adult skull is 39 degrees and is the same to the horizontal and the median vertical planes. The average normal optic canal in this series measures 4.1 by 4.65 mm. with virtually no variation depending on age, sex or racial stock.

Absolute symmetry of the optic canals may be expected in about 45 per cent of normal skulls; differences up to 10 per cent may be expected in about 40 per cent of normal skulls; differences of 10 to 20 per cent occur in about 14 per cent of normal skulls. An optic canal that measures less than 2.8 mm. in one of its diameters cannot contain a normal optic nerve.

A classification of the normal shapes of the optic canal is not of clinical value because pathologic canals present changes in the size or structure of their walls or both. An enlarged circular optic canal is indicative of optic nerve tumor. Certain constricted triangular canals are characteristic of certain skull deformities. Irregularity, erosion or destruction of any wall or part of a wall is always pathologic. Hyperostosis and exostoses are, of course, always pathologic.

DUNHAM, KENNON. The diagnosis of tuberculosis in the child's chest. *J. Am. M. Ass.*, Oct. 22, 1927, lxxxix, 1413–1414.

The greatest value of the roentgen-ray plate in studying children's chests lies in the ability to have an accurate record of the changing densities both during treatment and long after apparent recovery. From such studies the clinician is able to keep track of things, and the patient is more likely to be led to full recovery.

There is one roentgen-ray density that the author considers of great clinical importance; namely, the caseocalcareous lymph node. This is an enlarged tracheal, bronchial or pulmonary lymph node which shows flakes of calcification in its circumference. Many of these have been removed, roentgenographed and cut. They uniformly show calcification with caseation. They can be detected on the roentgen-ray chest plate, especially if lateral plates are taken. Such a density suggests caseation associated with beginning calcification and therefore that the process is not arrested. This finding is definite but not seen often enough to solve this important problem. Much of the calcification that is seen on the chest roentgenogram is evidence of infection but does not require treatment because it is arrested.

DUNHAM, KENNON, and NORTON, V. V. Basal tuberculosis. *J. Am. M. Ass.*, Nov. 5, 1927, lxxxix, 1573–1575.

Basal tuberculosis is quite common in the negro and not uncommon in white persons. This has been spoken of as the puerile type in the adult because it is like the disease as often found in children. The roentgen ray

affords an excellent way to differentiate these types but must not be relied on to make an etiologic diagnosis of basal tuberculosis.

Until more is known of the pathogenesis and pathologic anatomy of these lesions, it would be better to call them by their old name "basal tuberculosis," and include under this term the lesions simulating basal tuberculosis found in the upper lobes. We do know that miliary tuberculosis is generalized and that the fibroid apical type is often localized, and we want to know whether further studies will prove that the basal type is a part of a generalized tuberculosis as seems to be suggested by the present studies.

The pathologic anatomy and the pathogenesis of these lesions have not been definitely described. Further research is necessary to learn whether they are uniformly associated with lesions in other parts of the body. This is of practical importance, for if it can be proved that this type is uniformly associated with other lesions the belief becomes justified that this is a generalized form of tuberculosis. The report is based on a study of 60 cases seen in the past two years at the Cincinnati Tuberculosis Sanatorium. The etiologic diagnosis is very difficult from the history, symptoms, physical observations and roentgen-ray plates. The roentgen-ray plates will suggest the disease but the accurate diagnosis of basal tuberculosis depends on positive sputum, positive animal inoculation and other definite laboratory proof of tuberculosis. The only pulmonary tuberculous lesion which can be so diagnosed from the roentgenograms are apical lesions with fans of differing densities. Basal tuberculous lesions may closely resemble syphilis, bronchiectasis, malignant growths, hemorrhage or unresolved pneumonia.

Hedblom, Carl A. The diagnosis and treatment of bronchiectasis. *J. Am. M. Ass.*, Oct. 22, 1927, lxxxix, 1384–1390.

The diagnosis of bronchiectasis based on the ordinary clinical observations has often been doubtful as to the distribution and always incomplete as to the type and extent of the involvement. Bronchography by means of contrast mediums visualizes the presence, distribution and type of bronchial dilatation. In a series of 316 cases which the author studied before the introduction of iodized oil, 36 per cent were diagnosed as unilateral and 28 per cent as bilateral. This localization was probably erroneous in a considerable proportion of the cases. In 36 per cent the question of unilateral or bilateral involvement was put down as indeterminate. During the past sixteen months Dr. Jerome Head and the author studied 63 cases with the aid of iodized oil and found 45 unilateral and 18 bilateral.

The surgical treatment of bronchiectasis includes drainage, compression and extirpation. Drainage is the treatment of choice in single cavitations and for localized gangrenous extension. Artificial pneumothorax or temporary paralysis of the phrenic nerve or both are indicated as tentative procedures for pulmonary compression in early mild cases. Phrenicoexeresis and graded extrapleural thoracoplasty is the treatment of choice in cases of long standing. Primary lobectomy and graded cautery extirpations are not to be recommended on account of the high postoperative mortality and the frequency of residual bronchial fistula. Secondary lobectomy or graded cautery extirpation, when indicated, following thoracoplasty and phrenico-exeresis should prove relatively safe and highly effective.

Early accurate diagnosis made possible by contrast medium roentgenography with iodized oil and prompt surgical treatment should result in a maximum proportion of cures with a minimum of risk and of sacrifice of structure and function.

Kirklin, B. R., and Kendall, Edward C. A new iodine compound for cholecystography. *Radiology*, September, 1927, ix, 205–208.

Because of nausea, vomiting and purging which often follow the administration of sodium tetrabromphenolphthalein and sodium tetraiodophenolphthalein, and because of the uncertainty following the use of keratinized capsules and enteric-coated pills, a new compound for cholecystography would seem desirable. The authors present such a compound and after use on 35 patients have shown that it lacks the objections of the above substances, and yet gives a greater density of the gall-bladder with an absence of intestinal shadows. This compound is di-iodo-di-ethyl-ether of di-salicylphthalein. It is a crystalline white powder and a 10 per cent solution of its sodium salt, in which form it was given, is clear, colorless and odorless and slightly bittersweet. It is non-toxic to dogs in amounts up to 10 grams. When given by mouth to patients in doses of 7.5 to 10 gm. the gall-bladder shadow produced is denser than that from bromine salts. It is completely absorbed, since no shadow was found in the intestine.

The technique of administration is not different from that followed with the other salts. A bottle containing 10 gm. of the compound dissolved in 100 c.c. of water is given to the patient who is directed to drink it after the evening meal which is free from fats. Breakfast is omitted and films made at the

fourteenth, sixteenth and twentieth hour. After the sixteenth hour the patient eats a meal rich in fats. The pictures obtained are similar to those from the other salts, except for a greater density in the gall-bladder shadow, without shadows in the intestines. None of the patients vomited the new compound, but 2 were purged. A few experienced slight laxative effect. No patient had any other general ill effects and all preferred the new compound to the old ones. Further work is being carried on but the authors felt justified in making this preliminary report.

KNAPP, VICTOR. A modification in the administration of tetraiodophenolphthalein by the oral route for cholecystography. *J. Am. M. Ass.*, Dec. 3, 1927, lxxxix, 1967.

To lessen the frequency of undissolved capsules of dye inclosed in keratin-coated or phenyl salicylate-coated preparations, the author has been using an uncoated plain gelatin capsule. These capsules are filled with the dye as needed. The number of patients experiencing a gastric irritation is no greater with the uncoated capsule than with the coated one. The results have been better because undigested capsules are rarely found so that a maximum amount of dye is available for absorption. Eight 5 grain capsules are used on the average for each case.

KNIPFER, A. A case of leishmaniasis of the skin with unusual bone lesions demonstrated by roentgen rays. *Radiol. med.*, April, 1928, xv, 341–346.

The author reports a case which he saw in a little Arab girl twelve years of age, unlike any that he has been able to find in the literature. She had a Leishman ulcer of the front part of the foot verified by microscopic examination, and the roentgen picture showed extensive bone lesions. The lesions proved very sensitive to specific treatment and recovered completely without surgical intervention. Repeated examinations showed that there were no other bacteria present; excision of a bit of deep tissue near the bone lesions showed a structure on histological examination that was just like that of the Leishman ulcer itself. This shows that it was not a mixed infection involving the bone but that the bone lesions were caused directly by the Leishman parasite, in analogy with a case mentioned in the literature in which a gummatous necrosis developed below a Leishman ulcer; in this case, however, there was no roentgen examination of the bone changes. For comparison the author describes the roentgen results in a case of tuberculous ulcer, also on the front of the foot in a little Arab girl; there were tuberculous lesions of the bone beneath the ulcer with unusual macroscopic and microscopic characteristics. The tissue was infiltrated with round cells and there were many typical tubercles with giant and epitheloid cells.

LENARDUZZI, G. Roentgen examination of the small intestine in ascaridiasis. *Radiol. med.*, March, 1928, xv, 261–280.

Ascaridiasis is a much more frequent disease than is generally believed. On roentgen examination many ascarids and lesions of the small intestine caused by them are found in subjects who have never passed worms, or have not done so for a long time. The roentgen demonstration of ascarids is easy if the examination is made systematically with a good technique and sufficient care. Ascarids may be harmless in the intestine or they may cause a pathological condition with a rather varied symptomatology. The roentgen demonstration of ascarids has often cleared up obscure abdominal syndromes and prevented very serious errors in diagnosis. Ascaridiasis may be the primary etiological factor in mesenteritis, enterocolitis, appendicitis, cholecystitis, etc. From the clinical point of view it is very important to demonstrate changes in the movements and tonus of the intestine for these are very frequent in ascaridiasis and if no other cause is demonstrable it is safe to assume that they are due to that affection. In 43 per cent of the author's cases of ascaridiasis there were changes in movement and tonus of the small intestine and when such changes are found without any other demonstrable cause a very careful search should be made for ascarids. There are two kinds of changes in tonus and movement—either excess or defect. The latter are more frequent; they differ in degree and may show the roentgen syndrome of Vespignani. Operation in such cases may show the mesenteritis described by Donati. General and obscure intestinal symptoms indicate a roentgen examination, not so much to demonstrate ascarids, which can be done by an examination of the stools, as to determine whether the worms have caused any changes in the intestine.

MENEES, THOMAS O., and HOLLY, LELAND E. Oral cholecystography: comparison of methods. *Radiology*, September, 1927, ix, 213–218.

The authors compared three methods of oral cholecystography as follows: 100 cases were given sodium tetraiodophenolphthalein in Whitaker's stearic-acid-coated pills, 100 formaldehyde-hardened capsules, and 100 Oakman's salol-coated capsules. The Oakman method gave the largest percentage of satisfactory gall-bladder shadows. This is probably

due to the use of sodium carbonate as the alkali, which is powerful enough to form the soluble sodium salt from insoluble tetraiodophenolphthalein. This makes dye precipitated by the hydrochloric acid of the stomach again available for absorption. This sodium salt of tetraiodophenolphthalein shows a cumulative action following repeated doses, which is of much advantage in gall-bladders which do not fill, or fill poorly. The normal gall-bladder has less chance of failing to fill with repeated doses, which makes for accuracy of the oral method.

MEZZARI, A. Cyst of the lower end of the femur. *Radiol. med.*, April, 1928, xv, 364–369.

A man, aged forty-three, first felt a sudden pain and noticed a swelling over the inner condyle of the right knee in December, 1918. A diagnosis of tuberculosis of the knee was made and treatment given accordingly. No roentgen picture was made. He was sent to the author in July, 1927, with a diagnosis of tuberculosis of the knee-joint. He had no symptoms of tuberculosis elsewhere in the body, the tuberculin reaction was negative and roentgenoscopic examination of the thorax was negative. Roentgen examination of the tumor of the knee showed very clearly that it was not tuberculous. It was a cystic structure of the lower epiphysis of the femur; it was multilocular and the spaces were divided by strong septa of calcified bone. The signs of periosteal reaction were greatest on the median side where the tumor had grown most.

The author discusses the differentiation of the different kinds of bone cysts and thinks this was probably a benign giant cell sarcoma of the Bloodgood type. This is a form of central sarcoma which affects the ends of long bones and grows toward the periphery, transforming the end of the bone into a multilocular cyst. Recent studies tend to show that solitary true bone cyst, localized fibrous osteitis and giant cell tumor are not absolutely different diseases. He wished to excise a piece of the tumor for more careful examination but the patient refused.

He emphasizes the importance of systematic roentgen examination of all bone tumors for if a roentgen examination and correct diagnosis had been made in his case earlier suitable surgical measures could have prevented the extreme deformity which would now necessitate amputation.

MILANI, A. Paralysis of the diaphragm in unilateral exeresis of the phrenic nerve. *Radiol. med.*, April, 1928, xv, 359–364.

The author reports the roentgen findings in 60 cases in which he performed unilateral exeresis of the phrenic nerve in patients with tuberculosis in whom pneumothorax was impossible on account of adhesions. He found that exeresis of the phrenic produced paralysis immediately. There is some rise of the paralyzed half of the diaphragm immediately and it gradually increases. The final rise varies in the different cases from 1 to 9 cm., probably due to special conditions in the lungs, pleura and diaphragm in the different cases. Kienböck's phenomenon, or paradoxical movement of the diaphragm was found in 52 out of the 60 cases. But often it was not visible on normal quiet respiration, but deep inspiration had to be resorted to to bring it out. In other cases, it was only manifest in the terminal phase of inspiration, and during the first phase the diaphragm remained motionless. Or the paralyzed half of the diaphragm may in the first phase of inspiration present a trace of normal movement and in the second phase the paradoxical movement. The paradoxical movement generally does not begin immediately after the exeresis but only after some days, and then gradually increases. The paradoxical excursion is never more than 1 to 1.5 cm. Generally immediately after the operation there is immobility or slight normal movements. This is because it requires some time for the diaphragm to lose the resistance which it has by virtue of its muscle mass, but as degeneration and atrophy increase the paradoxical movement increases and is greatest when the diaphragm is reduced to a simple inert fibrous membrane.

There is no relation between the rise of the diaphragm after the operation and the degree of mobility that it showed before the operation. The greater or less mobility of the diaphragm before operation is due to adhesions and has no effect on the amount of rise of the diaphragm after it is paralyzed.

In all the cases the paralysis of the diaphragm persisted through the whole period of observation which in some cases was as long as three years, showing the value of complete exeresis of the nerve or at least the extirpation of a long enough tract to interrupt conduction in the chief trunk and the secondary branches.

MOORE, SHERWOOD. Cholecystography: A summary. *Radiology*, September, 1927, ix, 200–204.

This is a summary of the present information relative to methods used and interpretation of results in cholecystography.

Muzii, M. Anomaly in the arrangement of the human intestine. *Radiol. med.*, April, 1928, xv, 369–371.

A woman, aged fifty-six, had always had good health until about three years ago when she began to have digestive disturbance. Roentgen examination showed a hook-shaped stomach, the lower pole of which reached to the umbilicus. It was normal in form and function. The bulb of the duodenum was normal but the second and third portions instead of forming angles were in the shape of an arch which changed somewhat in size and form on change of position of the patient. There was no trace of a duodenojejunal angle. The whole of the small intestine was massed in the right half of the abdomen and the last loop of the ileum was directed from above downward and from right to left at its opening into the cecum. The cecum was located a little outside the midline; it was large and long and together with the ascending colon was directed almost parallel to the spinal column; at the level of the body of the first lumbar vertebra there was a downward loop and all the transverse and descending colon lay in the left half of the abdomen. The hepatic and splenic flexures of the colon were both to the left of the vertebral column and not far distant from it. The sigmoid described a small arch which brought it into contact with the cecum. There were no organic lesions of the digestive tract. The intestine was not abnormally mobile.

This case shows that congenital anomalies of the intestine due to defective rotation may persist throughout life without causing any important symptoms. There were no signs of vegetative neurosis in this case, which some authors claim always occurs in such cases, for the patient had been well up to the age of fifty-three and the symptoms which she had had since then were slight and yielded readily to diet and treatment.

Utili, V. Perforation of gastric and duodenal ulcers. *Radiol. med.*, April, 1928, xv, 305–308.

The author reports a case of gastric ulcer and one of ulcer of the duodenum in which perforation occurred within a few hours after a roentgen examination. He generally gives about 400 c.c. warm milk and water containing 100 gm. barium sulphate and a spoonful of bolus alba for a roentgen meal. He palpates the abdomen under roentgen control to determine the relation of certain rigidities of the abdominal muscles to parts of the digestive tract, to determine whether there is pain on pressure, to stimulate gastric tonus and peristalsis and to move the viscera for examination of certain parts. It has occurred to him that possibly in some cases palpation under these circumstances might be responsible for perforation of a gastric or duodenal ulcer. He brings the question to the attention of his colleagues and would like opinions as to whether they consider such injury possible and if so what measures should be adopted to prevent it.

Valdini, P. L. Cholecystography by the rectal method and the results of cholecystography in general. *Radiol. med.*, March, 1928, xv, 223–260.

In trying to determine the best method of rectal introduction of the substances used for cholecystography the author found that the injection could be simplified and made easier for the patient by giving an injection of pantopon a quarter of an hour before the introduction of 4 gm. tetrabromphenolphthalein dissolved in 120 c.c. water. For many reasons, which the author has discussed in previous articles, the rectal method is very much preferable to the oral method; it helps to make a more general use of the method of cholecystography possible as it can be used in many cases in which it is impossible to use the intravenous method.

He has used the rectal method in 68 cases which he discusses from the point of view of showing the importance which cholecystography has acquired in demonstrating lesions of the bile tract. The rectal method accomplishes this brilliantly by showing calculi or morphological and functional changes in the gall-bladder or in a less striking way if there is no shadow of the gall-bladder visible.

Cholecystography is of very great value in making a differential diagnosis between gastroduodenal ulcer and cholecystitis; it eliminates the latter by showing a normal gall-bladder or the former by showing calculi in the gall-bladder. But if there are both gastrointestinal changes and changes in the gall-bladder or no gall-bladder shadow the differentiation is not so definite and must be based on the clinical symptoms. If the gall-bladder is normal it refutes the hypothesis that cholecystitis is the cause of adhesions of the digestive tract in general and particularly of certain processes in the colon which are generally assumed to be due to cholecystitis. Cholecystography is also of great value in showing the coexistence of affections of the digestive tract and cholecystitis in cases in which the symptomatology is not very clear; it also shows decisively whether calculus shadows in doubtful cases are or are not in the gall-bladder.

Vallebona, A. Pseudocavities or annular structures in the lung. *Radiol. med.*, March, 1928, xv, 193–212.

Most authors think these annular structures are pleural in origin due to circumscribed pneumothorax but Vallebona thinks that sometimes they are due to a zone of circumscribed emphysema. Maragliano suggested this theory in 1912. He reports 2 cases of this kind in which the roentgen picture could not be explained either by true cavity or by circumscribed pneumothorax. The first of these cases he was able to follow up for four years and the second for a year and a half. Taking into consideration all the diagnostic signs, he concludes that the structures seen were due to zones of emphysema surrounded by a shell of sclerotic tissue. These were cases of chronic vesicular emphysema caused by a slow chronic form of tuberculosis with a tendency to healing manifested by sclerosis and calcification.

He discusses the cases of emphysema resembling pneumothorax which are reported in the literature and takes up the differential diagnosis between cavity and pneumothorax. In many cases a distinct differentiation can be made between cavity and pneumothorax by roentgen examination but sometimes the pictures are not decisive and it is impossible to decide between the two conditions. The author describes 3 such cases with autopsy reports in 2 of them. In both of the latter cases there were large cavities that had destroyed the whole upper part of the lung which was reduced to a thin layer of sclerotic tissue covered by the visceral pleura. It is obvious that the roentgen picture of such cavity would be very similar to that of a pneumothorax.

ROENTGEN AND RADIUM THERAPY

BAUMANN, M. Sarcoma development after roentgen irradiation for joint tuberculosis. *Strahlentherapie*, 1927, XXV, 373–374.

A report is given of a case occurring in a girl aged twenty-three, treated for seven years for a fungus of the elbow. She had received numerous roentgen treatments, and a sarcoma developed over the exposed regions. As a child she had suffered from numerous tuberculous foci and in 1920 she received seven usual roentgen treatments for the therapy of fistulas over both elbows. The right elbow, which later became sarcomatous, received treatments in 1925 and 1926. In April, 1926, she fell upon her right elbow and suffered a fracture of the upper arm close to the involved joint. In September, 1926, there was pain and swelling of the region. Roentgen examination showed instead of tuberculous granulation tissue, tumor-like masses which were found to be a polymorphocellular sarcoma. In October the sarcomatous portion of the humerus was removed. The inference that the roentgen rays were responsible for the development of the sarcoma seems to be quite convincing.

DAUTWITZ, FRITZ. The percutaneous radium treatment of benign uterine hemorrhages. *Strahlentherapie*, 1927, XXV, 311–327.

During the eleven years ending in 1925 the author observed 60 cases of benign uterine hemorrhages due to myomas, hemorrhagic metropathy and menopause. The treatments were made with 100 to 110 mg. radium element filtered through 1 mm. lead placed at a distance of 2 to 4 cm. from the skin, usually over the lower abdomen and often also over the sacral region. The duration of exposure was seven to eight hours. In patients with menstrual activity the treatment was usually given as soon after the termination of the period as possible. Series of 3 to 11 treatments were necessary to produce a result. Amenorrhea was not always regarded as the desired result for in many women a much more desirable effect of radium treatment is the production of a regular menstruation of normal intensity and duration. The treatments were given after pauses of one or more days depending on the individual case.

The above method of radium treatment is not only convenient but simple and avoids unnecessary and disagreeable complications in the patient. It also avoids a number of dangers inherent in the intrauterine method of treatment, especially infection. Experience shows that the intervening tissue irradiated by the percutaneous method does not seem to suffer any serious damage. The immediate side effects of the percutaneous radium treatment of benign uterine hemorrhages despite exposure of rather large sections of the abdomen are hardly worth mentioning. Once in a while, and then only after the first or second partial treatment, there was malaise for a few hours, but in no case a definite radium sickness such as has been observed following the internal application of radium. Moreover, there is absence of uterine discharge such as occurs after the intrauterine treatment. Thus far, cases treated for the production of amenorrhea have shown none of the acute disturbances of menopause but this may largely be due to the fact that most of the women treated for benign uterine hemorrhages were forty years or older and that the menopause may perhaps have occurred gradually.

Ten illustrative cases are briefly cited.

DEHLER, HANS. The radiation biology of cancer. *Strahlentherapie*, 1927, XXV, 239–254.

A report is given of a case of cancer en cuirasse of the breast occurring in a woman aged fifty-one. The condition was regarded as inoperable and referred for roentgen treatment. The supraclavicular field was treated in the usual way; but it was impossible to include all the involved region in one field and it was necessary to make the exposure through three fields. The first included the region of the mammary gland, the second included the axillary region; both of these reaching down to the level of the tip of the sternum. The third field lay beneath these two. For safety's sake, a small margin was allowed between the three fields. The treatment factors were as follows: focal skin distance, 70 cm. for the mammary field; 60 cm. for the axillary and 45 cm. for the lower field; filtration through 0.5 mm. Zn plus 2 mm. Al (first field); 5 mm. Al for the second and 3 mm. Al for the third. Each field received 100 per cent of the skin erythema dose. Eight weeks after treatment the patient showed definite skin pigmentation. The breast tumor had decreased considerably. However, at the unirradiated margins (0.5 to 1.5 cm. wide) between the three irradiated fields, there appeared two large sized nodules which were previously not present.

It is evident, therefore, that as between two risks it is safer to overlap fields by a few millimeters and reach every bit of cancer tissue than it is to leave a margin which invites the development of recurrences. Burns due to overlapping of fields present less danger to life and are more easily susceptible to treatment. Carcinoma is primarily a local disease and its treatment by radiation is a local problem similar to surgical treatment. The requisite for cure is the primary destruction of the viability of the cells by means of direct irradiation, which is essentially a medico-physical question. Only when this aim has been attained can interstitial tissue, blood and body fluids exert their activity in clearing up and restoring the strength of the organism. The actual cure of a cancerous condition is a biological process which depends on local conditions in the vicinity of the tumor and on the general condition of the body.

GERBER, ISAAC. Further observations on the roentgen-ray treatment of bronchial asthma and allied conditions. *Radiology*, September, 1927, ix, 192–199.

In the treatment of bronchial asthma with the roentgen ray, it is necessary first to be sure the condition is in fact this specific condition. For this purpose, this method has a very definite position in therapy. Direct treatment of the chest and mediastinal contents is more effective than the treatment of other organs, particularly the spleen. Treatment of the spleen is best reserved for refractory cases. Small doses of short wave length are employed on the chest and mediastinum, with only two fields, front and back. The diminution of the paroxysms is probably due to desensitization of the vagus nerve endings by the roentgen rays. For this reason it is also efficacious in the treatment of whooping cough and influenza. The use of roentgen rays in the paroxysmal stage of whooping cough is analogous to their use in bronchial asthma. This stage in whooping cough can either be aborted or greatly relieved in 75 per cent of the cases.

LAHM, W. The prognosis of irradiated carcinoma of the uterus in the light of microscopic examination. *Strahlentherapie*, 1927, xxv, 22–75.

The histological study of collum carcinoma in conjunction with experience in the radiation treatment of disease permits not only the drawing of certain prognostic conclusions but also permits a differentiation of the process of spontaneous healing from that due to the effects of radiation. The radiations produce a process which is not parallel to that occurring in spontaneous healing, but entirely different. It therefore appears that the aim in treatment should be such as to lead to the discovery of a method which will increase or resemble or replace the natural healing process, or enable the body to do so to the extent of causing recovery from the carcinoma. The connective tissue and histiocyte reaction in the region of the carcinoma as described by Opitz, Vorländer and Kok seems to play this rôle to just as little an extent as the leucocytic invasion.

Collum carcinoma shows a striking variation in type. It is, however, not difficult to distinguish certain recurrent types of cases. One characteristic is the epithelial structure. The reaction zone has not as yet shown any constant relations to the carcinoma type. Under similar methods of treatment the various collum carcinomas respond in decidedly different manners. Certain characteristics are demonstrable in the epithelioma and those in the reaction zone seem to have some relation to the prognosis of properly handled cases. There are certain difficulties in establishing definite rules owing to the fact that the dose capable of causing regression appears to vary among carcinomas of apparently the same extent. However, the matter is not settled and a solution may still be found.

Muir, Joseph. Radio-active substances: their therapeutic uses and applications. Gastric carcinoma treated by radium application. *Radiology*, April, 1927, viii, 330–335.

After a very exhaustive search of the literature the author was surprised to find that radium has been used so little in the treatment of gastric carcinomas. Results obtained in the early attempts were so discouraging as to limit further experiments in this field. In conjunction with surgery it has been shown to have a definite value and in very many instances has been responsible for prolongation of life and relative relief from pain in otherwise fatal cases. However, the inadequacy of external application is generally recognized and the failure of all efforts to put radium into the stomach without surgical intervention is admitted. It is possible that better results can now be secured with radium by the improved methods at hand. The dangers attending such use are obvious, not only to the condition being treated, but also to the normal tissue. It will be necessary to use an applicator so fashioned that irradiation of the healthy portions of the mucosa will be prevented, and yet permit only therapeutic rays to be brought to bear on the diseased area and excluding the caustic rays which induce necrosis. It appears that the implantation of radium has done more for advanced gastric carcinoma than surgery, and the radium therapist should consider the prospects for future success in curative methods as encouraging if developed properly.

Muir, Joseph. Radio-active substances: their therapeutic uses and applications. The value of radium in the treatment of mammary carcinoma. *Radiology*, May, 1927, viii, 416–421.

This is a review of the present state of our knowledge concerning the radium treatment of breast cancer. It is claimed by some observers that the adenomatous type of growth is more amenable to radiation than other types, but this is not as yet an established scientific fact. Inoperable mammary carcinomas have been rendered operable after radium exposure. This type of growth can be made to differentiate, thus reducing its rate of growth, by radium treatment. A condition described as "melting" has followed radium treatment of mammary carcinomas in cases reported by Alter. Before treating such cancers, a thorough examination should be made to determine the extent of lymphatic involvement and the case treated accordingly. There is a tendency to make use of radiation only as a postoperative precaution to clear up areas of infection which the surgeon did not or could not reach. For this purpose, the roentgen ray is used more than radium, but it is being gradually replaced by radium when this is readily available. A combination of the roentgen ray and radium has very greatly benefited many inoperable cases, either clearing up the condition entirely, or reducing it to a fibrous mass, which can then be removed locally. Axillary and even supraclavicular lymph nodes have been made to disappear entirely. The treatment in these cases consisted of primary irradiation by roentgen rays and then insertion of steel needles containing 10 mg. of radium element each. Under nitrous gas anesthesia the needles were placed 1.5 cm. apart for an eight hour exposure or 2 cm. apart for a sixteen hour exposure. Radium holds great possibilities in the treatment for carcinoma of the breast. It has been applied to cases considered hopeless and has proved its usefulness. A more extensive use of this form of radiation is justified and will probably be used to even greater advantage in the future.

Murphy, Douglas P. Substerilizing intra-uterine radium exposures: Report of twenty-five treatments. *J. Am. M. Ass.*, July 30, 1927, lxxxix, 373.

At the Rutherford Hospital, Rutherfordton, N. C., between July 1, 1922, and Dec. 31, 1925, thirty-eight women in the child-bearing age received varying sized intra-uterine radium exposures of less than 1000 mc-hr. each. One year following the last treatment questionnaires were sent out and answers were received from 25 patients. Their ages ranged from seventeen to forty-two years, average twenty-eight years. All were white but 2; 19 were married. Seventeen complained of metrorrhagia, 7 of menorrhagia and 3 of the latter suffered from severe dysmenorrhea.

Radon was used, filtered through 0.5 mm. silver, 1.5 mm. brass and 2 mm. rubber. The exposures varied from 250 to 862 mc-hr., average 526 mc-hr. Amenorrhea and hot flashes were frequent but inconstant sequelae and seemed to bear no direct relationship to the degree of exposure. In 22 cases, 15 reported greater regularity of their periods and 18 noted a definite shortening of each menstrual flow. The results show that future pregnancy can be expected without detriment to mother or child. The treatments are not without danger but this is relatively slight.

Pfahler, George E., and Widmann, Bernard P. Value of intravenous injections of dextrose during radiation treatment of malignant disease. *J. Am. M. Ass.*, Oct. 29, 1927, lxxxix, 1492–1496.

It has been suggested that the intravenous

injection of hypertonic dextrose solution in conjunction with radiation therapy renders cancer more susceptible to the effects of radiation. There are in the medical literature a number of enthusiastic reports on the general value of dextrose in a great variety of infectious and nutritional diseases. The authors' observations are based on a study of the effects of 1,044 intravenous injections in 111 cases as compared with general experience in radiation therapy of malignant disease over a period of twenty-eight years.

There is no evidence in this study to indicate that dextrose combined with radiation treatment of cancer improves the end-results, or in any manner renders cancer tissue more sensitive to radiation. Dextrose does not definitely prevent the so-called constitutional reactions or radiation sickness in all cases. Occasionally it does lessen the intensity and sometimes seems to prevent it, at least temporarily, so that its use deserves a trial when there is no interference with the comfort of the patient or the proper performance of the radiation treatment. The authors' conclusions are based on careful clinical observations and from general experience.

PORTMANN, U. V. Radiation therapy in malignant diseases of the thyroid gland. *J. Am. M. Ass.*, Oct. 1, 1927, lxxxix, 1131–1135.

A report is given based on observations in 166 cases of malignant diseases of the thyroid gland in which the diagnosis was established. Of all the patients treated or untreated 28.3 per cent are living more than one year, and 24, or 14.4 per cent, more than three years since they first came under observation. Amongst those who could be treated, 37.6 per cent are living more than one year, 24 or 18.8 per cent more than three years, and 12.8 per cent for five or more years after treatment was instituted.

Apparently the best results are obtained by operation followed by irradiation for in this group 22.6 per cent are "five-year cures," while 20, or 36.6 per cent are living more than three years after treatment. Of course if this plan of treatment is followed in all cases radiation will be applied in some cases in which the tumors are small, localized and encapsulated and which might therefore be cured by surgery alone; nevertheless, the final results indicate the advisability of applying radiation in every case of malignant disease of the thyroid. The explanation for this observation may lie in the fact that apparently the cellular structures of many malignant growths of the thyroid are sensitive to radiation because of their embryonic origin and because metastasis must take place through small vessels or lymphatics which are also comparatively susceptible to radiation.

Roentgenograms of the chest should be made in every case of thyroid enlargement and especially when a malignant condition is suspected. Pulmonary metastases in intrathoracic goiter or a mediastinal lymph gland involvement may be present even in cases in which the enlargement of the thyroid itself appears to be very small. In the present series metastasis in the chest occurred 11 times (6 per cent).

QUICK, DOUGLAS. Radium in adequate dosage in the treatment of cancer. *J. Am. M. Ass.*, Dec. 10, 1927, lxxxix, 2035–2039.

In spite of the fact that radium is not a specific remedy for cancer, it has come to occupy a well-established place in the field of cancer therapy. In the light of present knowledge treatment is virtually limited to surgery, radium and roentgen rays, the order of their relative importance mattering little since the best work is accomplished by various combinations of two or all three. The problem is a surgical one: radium and roentgen rays become surgical agents and should be so regarded. In order to attain adequate dosage, a supply of radium adequate in amount and in proper form is essential. Inadequate dosage is responsible for more so-called radium failures in suitable cases than all other factors combined.

Fractional doses, singly or repeated at long intervals, are inexcusable, and attempts to do big jobs with small amounts of radium are all too frequent. It is true that a few of the major types of malignant disease can be treated with relatively small amounts of radium, but only when the time factor permits of total heavy dosage. Only under certain circumstances of palliation are these small doses justifiable. In general, however, such palliation can usually be carried out more efficiently and more economically in other ways.

A good working rule to carry in mind is to assume that it is the last 10 per cent and not the first 90 per cent of the dose which makes possible the accomplishment of the desired result. Apart from all other considerations, the radium must be accurately placed. The technique involves: (1) the surface application of radium; (2) interstitial application, and (3) external distance application.

RAHM, H. Late necrosis of the mandibula following roentgen irradiations. *Strahlentherapie*, 1927, xxv, 338–345.

The bones and cartilage of the adult are regarded as being very slightly radiosensitive.

It seems, however, that it is necessary to revise this view because of observations to the contrary, as reported by Perthes and Jüngling. A case is reported by the author in which the evidence seems quite clear cut. The patient had been treated six years previously for a carcinoma of the lower lip which received intensive roentgen treatments after removal of the cancerous tissue and glands on both sides of the neck. First a series of four irradiations was given at intervals of five or six weeks, each treatment being over three fields, one on the right and one on the left side of the jaw and one over the wound. The rays were filtered through 0.5 mm. Zn, the dose applied being close to one skin erythema unit. After six months' pause, two similar treatments were given, the first including only a frontal field. After further wait of three months, another dose of one skin unit was applied over the scar.

In all almost one skin erythema dose was applied seven times in the region of the lower jaw within a year, a dose which two or three years ago would have been considered quite harmless. The effect of the treatment was first an epilation of the irradiated skin and two years later a mild chronic indurated edema. Recently there suddenly occurred a pronounced swelling on the left side of the jaw, the patient had a high fever and during the night the abscess perforated and established a fistula from the bone. The appearance was such as to cause suspicion that this was a recurrence of the cancer and not due to roentgen injury. The left horizontal branch of the jaw felt throughout somewhat thickened and painful on palpation. A roentgenogram showed an osteomyelitis of the mandibula without any actual sequestra but with a diffuse change of the bone without sharp demarcation. There was no active periostitis. Other roentgenograms showed two small sequestra.

The author has no doubt that this is one of those rare cases never seen in such uncomplicated form of a primary roentgen late necrosis of the jaw. This case shows that 100 per cent of the skin erythema dose is the greatest that should be applied to the bone and when this dose has to be repeated several times the interval between treatments should be sufficient, about six months. Such a dose should not be applied more than three to four times to the bone.

Robinson, G. Allen. Radium treatment in neoplasms of the upper air passages. *J. Am. M. Ass.*, Sept. 3, 1927, lxxxix, 751–753.

The use of radium in fibromas of the nasopharynx, polypoid ethmoiditis, rhinoscleroma and malignant tumors of the sinuses is described. Fibromas of the nasopharynx are usually pedunculated and arise from the vault of the nasopharynx, although they may originate in the posterior ethmoid or sphenoid sinuses. Their surgical treatment is attended with severe hemorrhages and frequent recurrences. Radium treatment has been found to be a safe procedure and to give good results. The present technique is to apply a 50 mg. radium tube to the pedicle of the growth for six hours in order to shrink the tumor and decrease the blood supply. After two or three weeks, platinum radon seeds are inserted into the tumor mass, with little or no danger of hemorrhage. Radiation necrosis of the tumor mass is to be avoided because of the danger of middle ear infection. In 8 patients treated with radium, 2 were successfully operated on after two radium applications, 5 are clinically cured with radium alone and one under treatment at the present time is improved.

Radium has been employed during the past five years with encouraging results in the treatment of polypoid ethmoiditis. Surgical procedures alone are known to fail often. Experience has shown that it is best to apply radium postoperatively in polypoid ethmoiditis. Within a week or ten days following the ethmoidectomy, a 50 mg. radium capsule should be applied to the ethmoid area for from two to four hours and repeated in about two weeks. About one week after the treatment there is a marked congestion of the mucosa with increased discharge. The inflammatory reaction subsides after a few days. The average number of applications is four, and the end-result of the treatment is a fibrous tissue formation in the mucosa and submucosa. A few polypi will recur in most cases but they are decidedly more fibrous in character; but the interval between recurrences is lengthened as a result of the radium treatments. Experience in nearly 40 cases has shown great relief from the treatment.

The action of radium in rhinoscleroma is to produce dense fibrous tissue replacing the loose granulation fibrillar mesh work in the submucosa. In early cases radium offers a good chance for cure, and in the advanced cases palliative relief is obtained. In 3 early cases with the disease localized to the nasal cavities there has been a clinical disappearance of the neoplasm. In 3 advanced cases the nasal obstruction was relieved for from two to four years.

A combination of methods gives the best end-results in the treatment of carcinoma of the antrum. Electrocoagulation has been of great value in destroying the mass without hemorrhage or danger of metastases. After the

growth has been removed and the cavity made accessible for radium application, intense gamma radiation is given. Two or three 50 mg. radium tubes screened with 1 mm. brass may be applied to the region for fifteen to twenty hours. A combination of deep roentgen ray and radium packs is applied externally over the cheek and the regional lymphatics. Of 17 patients with carcinoma of the antrum and accessory sinuses, 3 have remained clinically free from the disease for more than three years. Sarcoma of the nasal sinuses is more sensitive to radium treatment than carcinoma and surgical measures are best omitted or limited to biopsy. Deep roentgen-ray therapy plus radium packs will inhibit the growth and in some cases give clinical cure. Of 14 patients with sarcoma of the antrum treated with radium 2 are alive and have been well for five years, one for three years and 2 for two years.

ROFFO, A. H., and CARRANZA, F. Results of roentgen therapy in cancer of the uterus. *Bol. Inst. de med. exper. (etc.)*, Dec., 1927, iii, 539-552.

A series of 500 cases of cancer of the uterus treated by roentgen rays is reported. The authors found that even in cases in the third stage in which the tumor was inoperable there was considerable improvement in both the local and general condition. The improvement varied in degree and was so great in some cases that the patients thought they were cured. The tumors decreased in size and the discharge decreased or stopped entirely. But all of these improvements were temporary, for even in the most favorable cases in which the tumors were not very large and were so sensitive to the rays that cicatrization was complete, later examination showed recurrence and the longest period of apparent cure was eighteen months. If roentgen treatment is given again it does not cure the lesion but, on the contrary, hastens its growth. There seems to be no relation between the histological type of the tumor and the development after irradiation.

The value of roentgen treatment in cancer of the uterus is purely palliative. But while it must be admitted that there were no cases of real cure in this series it is also true that very few of the patients came for treatment in the first stage of the disease. Nevertheless these patients presented conditions that have been treated successfully by surgery. The results confirm the importance of early diagnosis in cancer, whether it is to be treated by surgery or roentgen rays.

RUD, EINAR. Blood studies of patients during radium treatment of carcinoma of the neck of the uterus. *Strahlentherapie*, 1927, xxv, 195-238.

The report is based on a study of 40 cases observed between 1922 and 1924. The ages varied from twenty-four to sixty-five years, the predominant age group being thirty-three to forty-six years. Most of the cases were regarded as inoperable, only 4 being in the operable group.

In more than half of the cases there was a decrease in the hemoglobin and erythrocyte content of the blood during the radium treatment. The decrease was of moderate degree and was rapidly compensated. The tendency to anemia appeared to be independent of variations in the dosage. Vaginal hemorrhages can be regarded as only partly responsible for this. There was no evidence to indicate the occurrence of a hemorrhagic diathesis or increased hemolysis. Infection does not seem to play a rôle in determining the degree of anemia produced. During the period of treatment the main feature was the decrease in leucocytes, especially after the first irradiation when the count dropped to 40 per cent of the original value. Three weeks after termination of treatment the leucocyte counts were either stationary or had stopped decreasing. The total leucocyte counts often dropped to the lower normal limit. As a rule, there resulted relative and often an absolute lymphopenia. After each irradiation there frequently occurred an initial leucocytosis predominantly of polymorphonuclear neutrophiles. Variations in dosage showed no noticeable effects. The changes observed occurred equally in the venous and capillary blood. In those cases in which leucopenia did not occur and in those with a leucopenia but showing a very uneven leucocyte curve, there was practically always present a transient high temperature and other signs of infection.

In a number of the cases there was a tendency to increase in the platelet count following irradiation, and in another group the tendency was toward a decrease. In general, it may be stated that no pronounced changes were observed and no thrombopenia could be established. The clotting time *in vitro* of the blood of these patients showed no typical change. During the treatment period and for three weeks after termination of treatment the coagulation time was short and remained unchanged.

A constant finding after radium treatment was a pronounced increase in the sedimentability of the erythrocytes. Three weeks after irradiation the velocity of sedimentation was in most cases very much higher than the initial value. The size of the radium dose and second-

ary infection appears to have no distinct effect on the sedimentation velocity. Of the other factors, the volume of erythrocytes appeared to exert a slight effect and the fibrin content of the plasma a more pronounced effect.

The blood examinations made a long time after termination of radiation treatment yielded the following results: In cases showing a favorable course, the hemoglobin and erythrocyte counts remained, as a rule, constantly normal or increased to normal values. The leucocyte counts returned to normal or remained there. The platelets were the first to show a tendency to decrease and the coagulation time a tendency to increase up to or approximately the normal value. The sedimentation velocity decreased or at any rate did not increase.

In cases with an unfavorable course the hemoglobin and erythrocyte count decreased (although not in all cases); the leucocyte counts varied irregularly, frequently increasing to a leucocytosis. The platelet count was as a rule permanently high or continued to increase; the clotting time remained shortened. The sedimentability remained very high or showed a tendency to further increase. Cases which preceding or during the treatment period showed a sedimentability of over 2.5 cm. had an especially bad prognosis. In cases showing an early favorable course but developing recurrences later on, the sedimentability remained either very much increased or began to mount after a temporary drop. In cases with recurrences the rate of sedimentation never showed a normal value and only exceptionally a borderline value.

SATTLER, EUGEN. A cured case of multiple sarcoma. *Strahlentherapie*, 1927, XXV, 190–192.

A report is given of a case occurring in a man aged forty-four who appeared in June, 1924, with the complaint of pains in the trunk, radiating toward the shoulders. The condition was suspected to be tuberculosis because of the patient's loss in weight. Rest treatment was of no help and the pains increased in intensity. A roentgenogram showed that the space between the 12th thoracic and 1st lumbar vertebrae was much narrowed and showed an angle projecting toward the left side. The 1st lumbar vertebra was shifted somewhat toward the right. At the left side of this vertebra there was a softening of about $\frac{3}{4}$ to 1 cm. in depth which extended from the upper portion of the vertebra but was free from the side. The region of the spine under examination was calcium poor. The diagnosis lay between tumor, tuberculous caries or gumma.

Placing the patient in a plaster cast for the treatment of the suspected tuberculosis produced no relief. A roentgen treatment was then given through a field 20 × 20 cm. at a distance of 50 cm., 1 skin erythema dose being applied over the 11th and 12th thoracic, the 1st and 2d lumbar vertebrae, and also over the left kidney region. This treatment took a total of about 118 minutes. In addition, four immediately adjacent fields 6 × 8 cm. were exposed to not quite a whole erythema unit, which required 23 to 24 minutes. The patient suffered a pronounced reaction to the treatment but after twenty-four hours the unbearable pain was lost and improvement followed rapidly. In April, 1925, two months after the roentgen treatment a new roentgenoscopic examination was made with the following finding: There were diffuse shadows extending backward under the spina scapulae and forward to the 2d rib. This shadow appeared to be a compact mass rather than fluid. At the right diaphragm toward the middle there was a nut-sized swelling visible, arising apparently from the upper portion of the liver. As a result of this finding a repetition of the roentgen therapy was instituted. Another series of treatments was administered in October, 1925, because of return of symptoms. After the treatment the patient again recovered and was able to return to work. This condition remained until March, 1926, when icterus suddenly appeared and became worse from day to day. The condition became acute and it was doubtful whether the patient could survive an operation. It was consequently decided to administer roentgen treatment again. An exposure was given through a field 20 × 20 cm. over the liver, gallbladder, pancreatic region, at a distance of 50 cm. with 80 per cent of the skin erythema dose, lasting 100 minutes. Dorsally there was applied 90 per cent of the skin erythema dose over each of four 6 × 8 cm. fields. For ten days the condition remained unchanged and then improvement gradually took place; and since the end of May the patient has remained entirely cured. This case is regarded as unique because of the existence of so many metastases which apparently were controlled by roentgen treatment.

SCHMIDT, WILLIAM H. Cancer of the tongue. *J. Am. M. Ass.*, Oct. 15, 1927, LXXXIX, 1321–1325.

Cancer of the tongue is one of the most important problems of surgery and it is far from the final solution. An exclusive surgical treatment has many defects and is limited in scope. Radiation therapy has proved dis-

appointing and although it has a place in treatment it has frequently been found to make matters worse.

The electrothermic method is regarded as a decided improvement and has opened the way for the relief of many formerly inoperable cases. The success or failure of the electrothermic method depends entirely on the treatment of the glands of the neck. Irradiation of these glands without surgical removal is the method of choice. The exercise of common sense and good judgment is considered highly necessary in planning and carrying out the roentgen-ray and radium treatment of affected glands.

SIMPSON, FRANK E., and FLESHER, ROY E. Radium in the treatment of vascular nevi. *J. Am. M. Ass.*, Dec. 10, 1927, lxxxix, 2028–2030.

Radium has practically revolutionized the treatment of vascular nevi. The cosmetic results of radium treatment are usually superior to those obtained by other methods. The degree of improvement that can be brought about depends on the type of nevus and the technique that is used.

In some cases radium treatment is slow and tedious. In a few the site of the nevus may become slightly depressed. In rare cases, attacks of dermatitis involving the treated area may occur for several years after treatment has been stopped. In some cases, and especially when the caustic action of the radium has been used, the treated area may become atrophic and whiter than the normal skin, and telangiectasia may develop. In rare cases the authors have noted an increased tendency to freckling of the skin over the nevus. However, other untoward effects have never been observed as a result of the radium treatment; and it is believed that the above undesirable effects may be avoided altogether by a proper technique.

The authors employ "toiles" of one-twentieth strength, round and square radium plaques of one-fourth and one-half strength, and in some cases several hundred millicuries of radon. "Toiles" are pieces of linen or rubber impregnated with radium sulphate. They are flexible, and can be easily shaped to conform to the irregularities of the skin surface. The radium plaques are of the type known as "glazed" plaques. In the treatment of all types of nevi overdosage should be carefully avoided. Inflammatory reaction should never be produced by radium until selective doses have been found inadequate. The authors nearly always use surface applications of radium or radon and in rare cases they have implanted radon tubes in the nevus.

SOILAND, ALBERT; COSTOLOW, WILLIAM E., and MELAND, ORVILLE N. The metallic colloids in the treatment of cancer. *Radiology*, June, 1927, viii, 469–481.

Colloidal forms of gold, copper and lead were used in the treatment of various forms of cancer. All of them gave rather discouraging results, only 2 of the 12 cases treated with lead showing definite improvement. Case reports of those treated with lead are given. All but the two became progressively worse and in 2 cases death was hastened due to the treatment. The lead treatment is dangerous, due to the toxicity of lead. The effect on the blood and kidneys is most marked. While this series of cases is small and no definite conclusions can be drawn from them, it is evident that none of the metallic colloids used were shown to be of value in the treatment of cancer, except the partial success with lead. If lead is to be used, much yet remains to be learned as to methods of use, dose, etc. The massive dose is very dangerous, and the divided dose has very little apparent effect. Even amounts one-half that recommended by Bell are dangerous. The experiences of the authors would indicate that even colloidal lead is impracticable in the treatment of cancer in the light of present knowledge of the subject.

STONE, WILLIAM S., and CRAVER, LLOYD F. The colloidal lead treatment of malignant neoplasms. *Ann. Surg.*, 1927, lxxxvi, 347–361.

A consideration of the problem as studied at the Memorial Hospital, New York City, leads the authors to conclude that the intravenous injection of lead does not appear to offer a cure for malignant neoplasms. It appears that in cancer of the breast, especially in bone metastases from this tumor, the lead alone can produce favorable changes, and, if used in connection with radium or roentgen rays, can cause regression sufficiently complete in advanced cases to make greater palliation in radioresistant tumors than has hitherto been accomplished. In malignant osteogenic sarcoma the authors' experience strongly suggests that lead in conjunction with radiation offers a valuable method of treating such tumors. No theory is offered to explain how lead produces changes in tumor tissues, but the failure to observe any favorable changes in a case of malignant chorio-epithelioma does not tend to confirm Blair Bell's theory of its selective action upon trophoblastic cells. It was not possible to make an accurate comparison of the present clinical results with those of Blair Bell's but they have been produced with less amounts of lead and consequently with less

constitutional damage. Changes have been observed in tumors after one injection of 80 mg.

The injections made by the authors were not given at definite intervals but after the patient had made satisfactory recovery from the previous injection. With the preparation of lead sol made in the chemical laboratory by Dr. H. Q. Woodward it was found unnecessary to use gelatin or other protective agent. Expressed in terms of milligrams of colloidal lead the authors do not advise a single dose of over 90 mg. in any case and they are inclined to think that 75 mg. will be a safer amount and will produce the same clinical effect. For patients weighing less than 100 lb. it is believed that a dose of approximately 1.5 to 2 mg. per kilo of body weight will offer a fair guide.

STÖRMER, A., and BREMER, F. W. Radiation treatment of syringomyelia. *Fortschr. a. d. Geb. d. Röntgenstrahlen*. 1926, XXXV, 547–553.

Brief reports are given of 9 cases treated by the authors. The observations have extended only a short time, but thus far the authors find it impossible to share the optimism of certain French observers who have claimed astonishing results. At any rate, in the 9 cases treated by irradiation, 3 showed good response and 3 others exhibited slight improvement. The remaining 3 cases were refractory to the treatment. The proliferating glial cells are regarded as the point of attack of the rays. It was found that the more recent symptoms are the most readily controlled by the treatment. It is safe to say that in cases showing an absolutely poor prognosis the radiation therapy may be recommended because the required roentgen doses have not been found to cause injury.

The roentgen tube is centered perpendicularly over the spinous processes, with slight compression of the tube, over fields 8 cm. wide and 15 cm. long. Each field is given 30 per cent of the skin erythema dose, repeated three times, with intervening periods of two to three days so that the skin receives a total of 90 per cent of the skin erythema dose per field. This technique delivers a depth dose at the disease focus of about 50 per cent. After about five weeks the whole series of treatments is repeated, followed by a sufficient period for further observation. The clinical condition of the individual case determines the time for a new treatment.

STÜMPKE, GUSTAV. The value of roentgen therapy in microsporia. *Strahlentherapie*, 1927, XXV, 358–361.

The author's experience in the roentgen treatment of alopecia due to microsporon has been satisfactory. Treatment consists of an epilation dose with irradiation over five fields. A preliminary treatment consists of use of 2 to 3 per cent salicylic acid ointment. Treatment after irradiation consists of a boric, salicylic or 5 to 10 per cent sulphur ointment. After irradiation there resulted a mild erythema which never was troublesome. There is a certain amount of difficulty in trying to treat small children but these can be managed.

Attention is directed to a new method of treating the disease which seems to be of value and also avoids the use of roentgen rays. This consists in the use of thallium acetate.

THEDERING, FRANZ. Spleen irradiation in skin diseases. *Strahlentherapie*, 1927, XXV, 328–336.

The author has been treating a number of cases cautiously with roentgen-ray exposures of the spleen. In no cases did the skin dose over the spleen exceed 2 × (Kienböck). The rays were filtered through 3 mm. Al, 25 cm. focal skin distance, spark gap 25 cm., 1.5 ma., maximum time of exposure never more than two minutes. The dose was always carefully measured and in all but one case there was no febrile reaction or significant disturbance of the general condition. The portal of entry was varied from the front, back or side, thus permitting continuation of treatment for three or four months.

The effects of the spleen treatments resemble very much those obtained in nonspecific protein therapy. The results were quite favorable and lead the author to assume that the action of the radiations is to produce an accelerated skin sensitiveness and an increased leucocytosis. After spleen irradiations one must be much more careful in local applications of ultraviolet and roentgen rays. Attempts to produce a favorable influence on skin carcinomas have been uniformly unsuccessful.

Reports are given of 4 illustrative cases of furunculosis. After irradiation of the spleen there was an accelerated response of the pustulosis and furunculosis with prompt healing. The author knows of no medicament capable of producing such a powerful and prompt response as he obtained with spleen treatments. Similar observations were made on old cases of lupus. After local treatments had been found to be ineffective, an irradiation of the spleen was able to stimulate the recovery process, as is shown in 3 illustrative cases which are cited. There were 2 cases of chronic urticaria, an old case of psoriasis vulgaris and an ulcerating tuberculous laryngitis which likewise showed favorable response to the spleen treatments.

Ullmann, H. J. The combination of colloidal lead and irradiation in cancer therapy. *J. Am. M. Ass.*, Oct. 8, 1927, lxxxix, 1218–1222.

Since lead is apparently changed to the orthophosphate by the body after it enters the blood stream and during this process marked injury to the red cells occurs, and since lead apparently can exist in the body only as the tri-lead or di-lead phosphate for any length of time, there was suggested the possibility that the use of colloidal orthophosphate as the primary material would reduce the toxic reactions. It was expected that as malignant tumors contain a certain amount of lactic acid and as the insoluble salt changes to the 100 times more soluble one in the presence of very small quantities of this acid, the tumors would be affected as by the metallic preparation. Experiments upon rabbits showed that the colloidal lead phosphate was considerably less toxic insofar as its effect on the hemoglobin was concerned. The preparations were also tried on patients and the toxic effects were also much less than those produced by colloidal metallic lead. It is too early to render statistical clinical reports, but the author's experience leads to the belief that lead markedly affects certain tumors and that one of the effects is to render the tumor distinctly sensitive to irradiation. This sensitiveness does not appear for some little time after an appreciable amount of lead has been given.

Two case reports are briefly cited to show the effect of the phosphate on tumors. These are not presented as evidence of the value of the method but as interesting observations. There seems to be sufficient evidence to warrant intensive investigation either to develop this method of treatment or to prove it useless.

Ullmann, H. J. The use of colloidal lead in the treatment of cancer after the method of W. Blair Bell. *Radiology*, June, 1927, viii, 461–464.

The writer presents some of his experiences with colloidal lead as suggested by Bell, and found the treatment open to disadvantages which have not as yet been overcome. Because of the greater stability of lead orthophosphate and its slight toxicity, this form of lead treatment offers promise of being safer to use and just as efficient as Bell's preparation. In the presence of slight acidity, such as the lactic acid contained in malignant tumors, this insoluble salt is changed into a more soluble form and will thereby become more effective, without at the same time having a deleterious effect on the blood. Comparative experiments showed that the lead phosphate had no effect on the hemoglobin in the blood of rabbits in doses of from 4 to 16 mg. per kilo over a period of six days. The same result has been noted in human patients, the toxic effects being negligible. It is too early to judge of the clinical value of either of the two preparations, but the benefit claimed for the colloidal lead as prepared by Bell is noted with the lead phosphate. The lead phosphate treatment can be considered a distinct advance over the colloidal lead preparation of Bell in that the toxic effect on the blood is practically eliminated.

Werner, R. Further report on the results of the radiochemical treatment of inoperable malignant tumors of man. *Strahlentherapie*, 1927, xxv, 76–104.

The "radiochemical" treatment consisted of the combination of injections of enzytol (composition not stated) with small field irradiations of roentgen rays or radium. The treatment varied from case to case, but consisted essentially of several roentgen exposures of $\frac{1}{2}$ skin erythema dose each, with simultaneous injections intravenously or intramuscularly of enzytol. Numerous case reports are cited of mammary carcinoma, malignant lymphoma, adenocarcinoma, stomach carcinoma, bone sarcoma, carcinoma of the rectum, of the bladder, prostate, uterus, ovary, and of malignant struma. The citations are claimed to be illustrative of the treatment; and the results reported include all the cases from the beginning of the treatment, some being cases surviving ten years or more and others surviving three to ten years.

The effect of the combined treatment appears to assume one of three different forms: (1) A few series of treatments suffices to yield the maximum effect. This was especially noticeable in certain cases of carcinoma of the stomach but it occurred very infrequently. (2) More usually a prolonged and oft repeated treatment is required before a final cure is obtained. This involves a fight against the disease over a number of years. Temporary improvements alternate with regressions until recurrences fail to make their appearance and the patient remains free from symptoms for years afterwards. (3) However, the most usual outcome of the treatment is failure to attain cure. Freedom from symptoms may be produced for a number of years, but finally recurrence appears which behaves refractorily to the treatment and causes the patient's death. It was impossible to determine whether there was any external factor of exhausting disease or trauma or something of that nature which was responsible for initiating the recurrence of the disease.

WHITE, WILLIAM C. Late results of operation for carcinoma of the breast. *Ann. Surg.*, 1927, lxxxvi, 695–701.

A report is given of five-year end-results obtained at the Roosevelt Hospital in 157 cases operated on from Jan. 1, 1912, to Dec. 31, 1922. This particular series of cases did not receive much radiation therapy. Many had extensive roentgen-ray and radium treatment after the appearance of recurrences, but for present purposes of classification such recurrences were classified with the dead since the factor of increase in length of life did not enter into these statistics.

There were 5 operative deaths. At the end of the five-year period 36 per cent of the 157 were alive and well; 19 per cent of the cases developing axillary metastases were alive and well as compared with 70 per cent of those without metastases. In this series there was a group of 61 cases followed up for ten years and of these 24 per cent were free from recurrence at the end of the period. Of cases free from axillary metastases about 50 per cent may expect to be free from recurrence.

Definite metastases in the supraclavicular region are a contraindication to operation as is also large extension to the axilla. A palliative operation may be justified for the mental effect on the patient but not from the point of increasing length of life. Operation may also be worth while to prevent the annoyance of a sloughing ulcer. A study of the cancer cell in relation to its adenomatous formation, secretion, size variation, nuclear changes and hyperchromatosis gives one a clue as to the relative malignancy of the particular cancer of the breast investigated. It is not as certain as the information derived from a study of epithelioma of the lip.

The author does not believe irradiation before operation to be of proved value. Irradiation after operation has not lowered the mortality in the second half of the ten-year group. Nevertheless the author has not abandoned the belief that it may do some good and for the present will continue to advise its use after operation.

WINTZ, H. Causes for the failure of the radiation therapy of carcinomas. *Strahlentherapie*, 1927, xxv, 1–21.

Examples are cited to show that it does not suffice to apply roentgen rays in a purely mechanical manner to the treatment of carcinoma. One aspect of the problem is the question of exact dosimetry. Above all, an absolute dosimetry must be established if comparisons are to be made between the treatments employed at different institutions. Such a comparison is at present not possible. We are able as yet to apply roentgen rays with only approximate precision. Overestimation of our dosimetric knowledge has often led us to assign to the unknown biological factor results properly belonging to the domain of dosimetry.

In the radiation treatment of carcinoma there are a great number of unknown biological factors that have to be understood; but this will only be accomplished after the establishment of an absolute basis of dosimetry. The author therefore regards it as worth while to continue the study of the problem of dosimetry and to emphasize it more than the biological aspect.

WOOD, FRANCIS CARTER. Effects of combined radiation and lead therapy. *J. Am. M. Ass.*, Oct. 8, 1927, lxxxix, 1216–1218.

A previous paper by the author presented certain evidence with experimental tumors in animals that a combination of lead suspensoid injected at suitable intervals and in suitable doses increased the sensitivity of certain neoplasms to the action of the roentgen ray. The present report is a continuation of that investigation. The two tumors used in the experiments were rat sarcoma No. 10 and the Flexner-Jobling rat carcinoma.

The application of suitable doses of roentgen rays made very little difference in the growth of the sarcoma No. 10 and the lethal dose of roentgen rays was the same with or without the lead treatment. The result seems to be, therefore, that in a very highly malignant growth of this type a combination of lead and the roentgen ray was of no more value than the roentgen ray alone.

On the other hand, when the Flexner-Jobling carcinoma, which grows somewhat more slowly and is less prone to extensive central necrosis even after the lead treatment was used, it is quite apparent that the administration of even very small doses of lead made the tumor more sensitive to radiation. Thus instead of having to give four erythema doses to kill the tumor, three will produce marked reduction in size if lead has been added.

The author believes that in the future, instead of lead being used as a primary form of therapy and the roentgen ray as an adjuvant, the situation may be reversed, and the radiotherapist will give lead to the patient in order to increase the effectiveness of the roentgen ray. Whether this opinion is valid can be determined only by the most careful studies on human beings and on animals.

It is concluded, therefore, that the combination of lead and the roentgen ray is more effective than either alone on a rat carcinoma of

high virulence. On a rat sarcoma of greater growth capacity no such increase in the effectiveness of the roentgen rays can be observed. A preliminary study of the effects of the addition of dextrose to lead mixtures or of preliminary injections of dextrose followed by lead has shown that the dextrose does not seem to increase the efficacy of the lead in its action on tumors, nor does it apparently increase the efficiency of the roentgen ray.

ZACCARIA, A. Roentgen irradiation of the spleen in metrorrhagia at puberty. *Radiol. med.*, Feb., 1928, xv, 169–174.

The author reports the good results obtained in 12 cases of metrorrhagia at puberty by roentgen irradiation of the spleen. It not only brought about increased coagulability of the blood but also increase in the number of red and white corpuscles and platelets. The good effect of the treatment was rapid and certain; there was an astonishing improvement in the patients' condition a few weeks after the first cycle of irradiations. Regular menstrual function was re-established in all the cases.

The author reviews the experiments of different workers who report that the spleen not only manufactures red and white blood cells but has an effect on the general growth of the body. He advances the theory that possibly irradiation of the spleen stimulates the emission of red and white corpuscles into the circulation and that they exercise the action which the spleen has on the growth of the body. In this way they correct the state of exhaustion which is brought about in young girls by excessive menstrual flow. He also thinks that these irregularities result from insufficiency of the uterus and ovary, and the stimulating action of the spleen also helps to establish equilibrium in the development of the sexual organs.

He uses a non-intensive apparatus, but he says too small doses should not be used as they would have no effect. He gives three irradiations the first week and repeats them a month later; a third cycle is given five to six weeks after the second. The doses run from a minimum of $\frac{1}{4}$ to a maximum of $\frac{1}{3}$ of a skin erythema dose; focus-skin distance 30 cm., filters 0.5 mm. zinc and 2 mm. aluminum; 130–145 kv., 2 ma.

MISCELLANEOUS

BECCHINI, G. Pathogenesis of the changes in the leucocytes after roentgen irradiation. *Radiol. med.*, March, 1928, xv, 216–222.

The author describes experiments made on rabbits in which he irradiated a short tract of the carotid artery which was isolated from the rest of the tissues, the latter being protected by lead. As soon as the irradiation was finished the part of the artery that had been irradiated was removed and examined. From the results of these examinations he concludes that the changes in the blood after the use of roentgen rays are due to a direct injurious action of the rays on the cells in the circulation and possibly also in part to a secondary injurious action on the hematopoietic organs.

BELOTE, GEORGE H. Iododerma from iodized oil. *J. Am. M. Ass.*, Sept. 10, 1927, lxxxix, 882.

A report is given of a case occurring in a man aged fifty-seven, the iododerma being caused most probably by lipiodol. There was an acneform eruption involving the face, upper trunk and arms, such as is commonly caused by iodide or bromide. No bromine was found in the urine but iodine was present in large quantities. A thorough investigation of the patient's record since 1926 reveals three possible sources of iodine. He received tetraiodophenolphthalein by mouth for cholecystography on Dec. 29, 1926; from Jan. 11 to Jan. 16, 1927, he received three times daily 15 grains of potassium iodide and on March 29 his lungs were injected with lipiodol. The eruption appeared on April 6 or 7. On April 13, 14 and 15 the urine and saliva were strongly positive for iodine and a reexamination of the chest by roentgen ray showed the presence of lipiodol in the lung tissues. Since all the other iodine preparations had been administered by mouth at least three months previous to the appearance of the eruption and since such compounds are rapidly absorbed and eliminated, it is not possible that they could have been the cause of the eruption. The assumption that the lipiodol was responsible seems to be convincing. Whether the iodine was actually being absorbed from the lungs or whether it was coming from the sputum swallowed is impossible to determine.

BONANNO, A. M. The effect of roentgen rays on skin allergy in tuberculosis. *Radiol. med.*, April, 1928, xv, 346–358.

Before taking up the effect of roentgen rays on allergy in tuberculosis the author discusses the modern theories invoked to explain tuberculous allergy and the causes which act on it in either a positive or a negative direction. He briefly describes the mechanism of action of roentgen rays and shows that the effect of such irradiation is similar to that of the introduction of protein bodies. He practised the cutireaction and the intradermal reaction to tuberculin in about 100 patients who were being given

roentgen treatment for different diseases and found that many of them who had a negative skin reaction to tuberculin before the treatment had a positive reaction after 4 to 10 treatments, and the reaction remained positive for some months. The cutireaction and the intradermal reaction to different substances, such as mallein and bacterial extracts of typhoid and paratyphoid did not show any great changes except in a very few cases and after several applications of roentgen rays. In 6 cases of malignant lymphogranuloma the skin reaction to tuberculin remained constantly negative. The author tries to explain the appearance of a positive skin reaction to tuberculin after roentgen treatment in subjects who were previously allergic by comparing the action of roentgen rays on tuberculous subjects to that of the substances used in stimulant therapy, that is to say, the substances to which tuberculous subjects react more quickly and with greater intensity than subjects free of that disease.

BORAK, J. On the mechanism of action of roentgen rays upon carcinomas. *Strahlentherapie*, 1927, XXV, 105–120.

A report is given of a case occurring in a woman aged seventy-four, appearing with a basal cell carcinoma on the left thigh. The application of a dose of 24 H administered at each of three sittings did not produce the usual disappearance of the tumor in four weeks. The course was striking and entirely atypical. In the course of the three months after irradiation there occurred an extensive cleaning out of the base of the tumor, the margin became very sharp but no skin formation occurred over the tumor surface. A biopsy of the tumor margin showed no microscopic signs of the pre-existing neoplasm. Finally, the whole area sloughed off leaving a clean sharp margin and exposing the underlying muscle fascia. A skin transplantation was performed.

It appears therefore that the two fundamental processes following irradiation of tumors, namely, regression of the tumor tissue and new formation of normal tissue are not strictly independent processes but merely two phases sharply differentiated by their time of appearance. In the present case only the first made its appearance, demonstrating that the second might be entirely absent.

BOYDEN, EDWARD A., and SAUNDERS, A. M. Duodenal drainage of the human gall bladder. *Proc. Soc. Exper. Biol. & Med.*, March, 1928, XXV, 458–462.

In view of the consensus of opinion that magnesium sulphate is not absorbed by the intestine, and believing that evacuation of the gall-bladder might be induced by mechanical stimulation, the authors injected air into the duodenum through a Rehfuss tube and then examined the patient roentgenoscopically at short intervals—computing the volumes of the gall-bladder by the Boyden method. In 3 out of 4 individuals subjected to this procedure, the gall-bladder showed measurable reduction in size after inflation of the duodenum. In one case dilatation ensued, a reverse effect which is interpreted as a reflex inhibition of the gall-bladder due to sudden and forcible inflation of the duodenum.

In each of the 4 cases egg yolk was subsequently injected into the duodenum in order to test the motility of the gall-bladder. This food induces as effective a contraction phase when thus administered as when taken by mouth. Having ascertained the reaction of the gall-bladder to inflation of the duodenum, concentrated magnesium sulphate was then tried. In the first case a small amount was injected and the drug was ineffective. In the other 2 cases there occurred a rapid change in shape and volume indicating a vigorous contraction of the gall-bladder induced by the presence of magnesium sulphate in the intestine. Three hypotheses may be offered to explain the results but whatever the interpretation there can be no question of the fact that when magnesium sulphate is injected into the duodenum it induces marked contraction of a distended gall-bladder and consequent expulsion of bile.

BOYDEN, EDWARD A., and PARMACEK, LOUIS. Reflex inhibition of the human gall bladder. *Proc. Soc. Exper. Biol. & Med.*, March, 1928, XXV, 462–464.

Evidence is presented to show that the gall-bladder is under nervous as well as hormonal control. Usually the ingestion of water results in the discharge of bile from the gall-bladder, but in one case reported the response was not a contraction but a dilatation of the gall-bladder. This person was found by the Goetsch test to be markedly vagotonic. Following drinking of a glass of warm or cold water or milk there occurred sudden dilatatation of the gall-bladder which was not merely a filling of the reservoir following abrupt closing of the sphincter but due to relaxation of the gall-bladder musculature. The cholecystograms showed exceedingly rapid dilatation. A similar case of dilatation may be induced by forcible inflation of the duodenum through a Rehfuss tube.

CAREY, EBEN J. The anatomy, physiology and anomalies of the spine. *Radiology*, September, 1927, IX, 219–234.

The author points out the importance of a thorough knowledge of the anatomy, physiology and anomalies of the spinal column in order that the roentgenologist may be prepared to interpret his roentgenograms. Chronologic changes are important and can be observed only by means of roentgenograms made at various periods in development. Such studies by means of roentgenograms should be made a part of the instruction in medical courses in anatomy. Roentgenograms are given to illustrate some of the points emphasized by the author.

Carnett, John B., and Greenbaum, Sigmund S. Blood vessel visualization. *J. Am. M. Ass.*, Dec. 10, 1928, lxxxix, 2039–2041.

Experimental work was undertaken to determine whether or not visualization of the blood vessels was possible in the living subject. Sodium iodide, potassium bismuth tartrate, and dominal x gave unsatisfactory roentgenologic films in animals. After extensive experimental injections in rabbits, the authors have found that 6 c.c. of iodized oil may be injected into the femoral artery of the average man with perfect safety. This quantity has been used in 10 cases. The injection is made slowly with the result that the iodized oil usually appears as globules in the femoral artery. Further down the globules coalesce and appear as a solid stream. Roentgenograms are made with the utmost promptness on completion of the injection. The femoral pulse is shut off by a tape constriction during the time required to inject the artery and make the first series of roentgenograms. The first leg pictures taken are, as a rule, better than the subsequent ones. The terminal vessels in the foot are generally best shown in the five-minute film. After ten minutes very little iodized oil remains in the lower extremity. Roentgenograms of the abdomen and chest fail to reveal any iodized oil. Great care should be exercised in handling the injected limb not to compress or squeeze it before roentgenography, as the oil is forced out of the vessel and its roentgenographic continuity destroyed.

Ten roentgenograms accompany this article to illustrate the results obtained. One of the most interesting observations was in a case of thromboangiitis obliterans showing tortuosity of the vessels as a marked feature.

Ceresole, G. An artifice which accentuates the transparency of the extreme apex of the lung. *Radiol. med.*, March, 1928, xv, 213–215.

When examining the apex of the lung the author has the patient flex his head and rotate it strongly toward the side opposite the one to be examined. This lifts the first rib on the side to be examined and enlarges the first intercostal space. When this space is transparent it means that the apex of the lung is normal; if it is veiled it means that there is a cortical pleurisy of the apex. The advantage of using this method is that it shows very limited lesions which might be hidden by the shadow of the first rib if the picture were taken with the head held up straight and in the median position.

Eberts, Edmond M., and Fitzgerald, R. R. Malignant disease of the thyroid gland. *Ann. Surg.*, 1927, lxxxvi, 515–531.

An analysis is given of 14 cases from the Montreal General Hospital. The records of the goiter clinic from 1920 to 1926 inclusive cover 687 cases of goiter of which 612 were operated upon. Of the latter 346 were of the adenomatous type. Four cases were malignant, that is, 0.8 per cent of the total number, 1.8 per cent of the operated cases and 3.1 per cent of the adenomatous cases operated on. These percentages agree fairly well with those of other goiter clinics. The various clinical features of these cases are analyzed.

Sixteen operations were performed upon 11 patients in this series. There was no operative death, 2 have died since the operation, one has been lost track of and 8 are alive. Of the 3 cases not operated upon, one died and 2 are presumably dead. Of the 8 cases known to be alive, the postoperative period varies from five weeks to five years; 2 between four and five years; 2 between two and three years; one between one and two years, and 3 less than one year. Although it is unsafe to pronounce any of these cases completely cured, the results in a few of them are extremely gratifying. A second operation was performed in 2 of the cases and a third operation in one case. This last patient is still alive four years and two months after the first operation.

The cases in this series are reported briefly and there is appended a list of references to publications since L. B. Wilson's paper in 1921.

Ford, Frances A. The effect of roentgen rays on the development of tuberculosis in guinea pigs. *Radiology*, September, 1927, ix, 235–240.

When a dose of roentgen rays comparable in penetration to that used in the treatment of human beings is applied to guinea pigs infected with virulent tubercle bacilli the course of development of the disease was not checked or retarded. Guinea pigs are very susceptible to tuberculosis and the amount of inoculation with the tubercle bacillus was much more than

would occur in practice, and for this reason the inability of the roentgen treatments to affect the course of the disease might be explained. It is necessary, also, that the entire animal be subjected to the action of the rays, and this, too, may have some effect on the results obtained. The results obtained indicate even earlier tuberculosis after treatment with the roentgen ray than without. Ultraviolet exposures did not prevent the development of tuberculosis in 6 guinea pigs tested.

FRÄNKEL, ARTHUR. The roentgen cinematography of the stomach and its critics. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, XXXV, 650–662.

Martin Haudek has taken occasion to criticize the method of roentgen cinematography and in view of the importance of the subject, the author takes occasion to review Haudek's objections. It is pointed out that the customary fluoroscopic study and the proposed cinematographic study are not antagonistic nor is one a substitute for the other.

FRANK, JOSEF. Certain inadequately considered points in roentgen-ray dosimetry. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1926, XXXV, 633–635.

In applying the roentgen-ray dose using the time of exposure as the measure of dose, there are three important factors which do not appear to have been considered with sufficient care. These are (1) the variations in roentgen tubes; (2) the unreliability of the so-called sclerometer when carelessly employed, and (3) the possible effect on tube voltage and dose due to inadequate high tension resistances.

FRIEDENWALD, JULIUS, ZINN, WAITMAN F., and FELDMAN, MAURICE. Cancer of the esophagus. *Am. J. M. Sc.*, 1927, clxxiv, 609–623.

An analysis is given of a series of 128 cases occurring in the gastro-enterological clinic of the University of Maryland. The disease is not uncommon but occurs less frequently than cancer of the stomach. It has been observed far more often in males, occurring in about the proportion of five males to one female. The disease is more apt to affect those sites presenting physiological narrowing of the lumen, that is, the entrance to the esophagus and the aortic, bronchial and diaphragmatic constrictions. The most common varieties of growth are the squamous cell epithelioma and adenocarcinoma; these two varieties represented 90 per cent of the cases.

The early symptomatology is indefinite and the premonitory signs vague and inconstant. The patient frequently complains at first only of unusual sensations in swallowing and of a lump rising into the throat. A prominent and early sign is dysphagia, and regurgitation of small amounts of blood may be observed occasionally at this stage. The recognition of early carcinoma of the esophagus can best be accomplished with the aid of the roentgen ray and esophagoscopy. The seat of the obstruction may be determined as well as its degree, the extent of the growth, length of the stricture, character of the dilatation above and surrounding involvements. The roentgenoscope offers an ideal method for the examination of esophageal conditions. In all instances roentgenoscopy should precede esophagoscopy. The first roentgen-ray sign of early carcinoma is a slight irregularity in the lumen of the esophagus which does not, however, produce delay in the passage of the meal. Even the roentgen-ray signs may be rendered uncertain by other conditions which may mask the actual disease.

Roentgen-ray examinations were made in 116 of the present series of cases. According to the authors' experience the dilatation of the esophagus in cancer is not so extensive as that observed after cardiospasm.

The danger attending radical removal of the growth is so great that this procedure cannot be urged upon patients even though a few successful instances of removal have been reported. Considerable though only temporary relief may be obtained by means of gastrostomy if not performed too late. The dilatation of the carcinomatous stricture by means of bougies and the use of radium are procedures which according to the experience of the authors are of doubtful utility.

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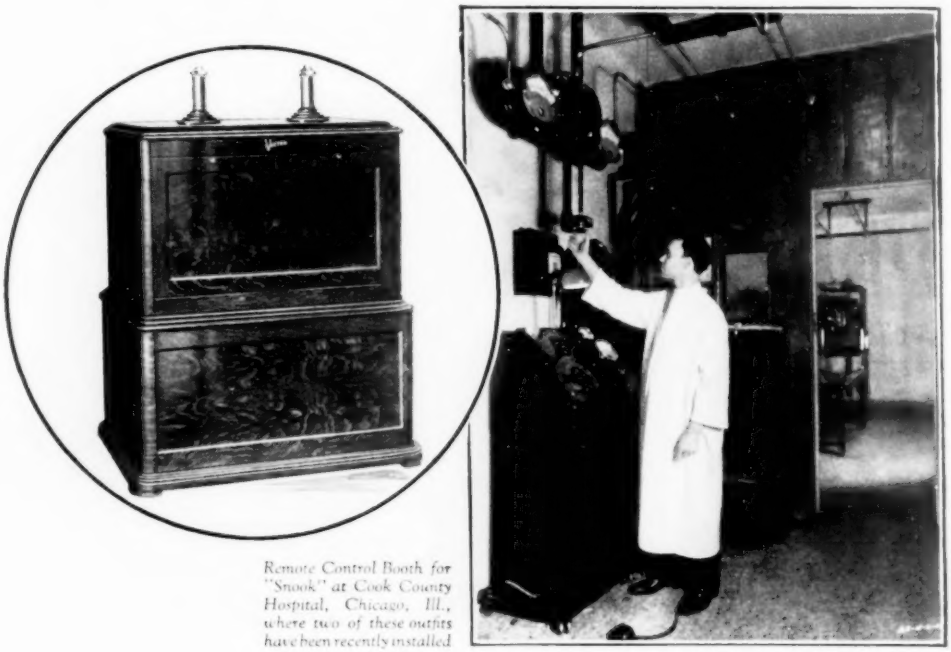

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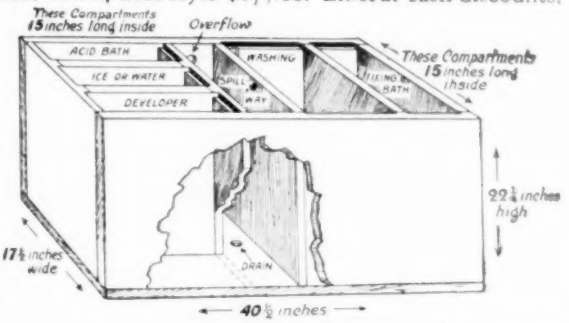

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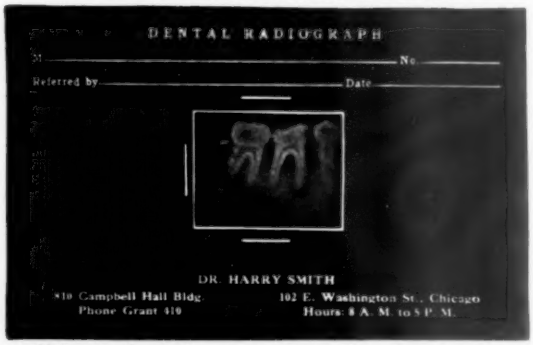

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